For Japan: S. Yoshizoe, Botanical Garden, Imperial University, Tokio.

Journal of Applied Microscopy and Laboratory Methods

Vol. IV *October, 1901* *No. 10*

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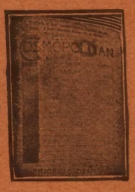

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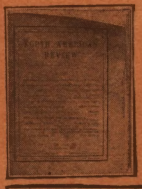

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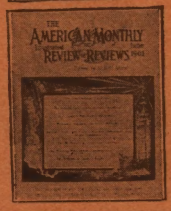

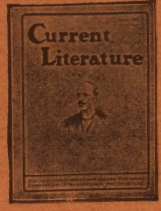

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Epidermis, Helonias bullata.
Petiole of Gastronia palmata.
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Fibers of Cork Tree, Natal or Australia.
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Ovary of Ficus.
Petiole of Palm.
Plant Hairs, Lepicystis sepueta.
Trans. sec. Ash, F. americana.
Red Rust on Wheat.
Kalium chloratum.
Tr. sec. Leaf of Hoya carnosa.
Stem of Sequoia.
Stellate hairs on leaf of Shepherdia canadensis.
Enchondroma of Clavicle.
Starch of Potato.
Tr. sec. Stem Mimosa eupulina (Sensitive Plant).
Leaf of Croton.
Kidney and Supra Renal Capsule of a Rat.
Hornbeam Stem, Carpinus americana.
Scales on Leaf of Chenapodium album.
Uterus of Heifer, stained.
Pollens grains, Hibiscus moschentos.
Wheat Smut.
Arrow-root, Orientale.
Canada Thistle, Cirsium arvense.
Banana, Musa sapientum, spiral fiber of fruit stalk.
Epithelial cells, lip of child.
Leaf of Myrica cerifera.
Inorganic Salts.
Armoracia rusticana, spirals, Petiole Tr. and Lg. sects.
Spore Cases of Fern.
Uterus of Heifer.
Testicle of Dog.
Blood of Sheep.
Rat's Penis.
Arachnoidiscus, Puget Sound.
Human Fibrous Tissue.
Cork.
Trifolium pratense, Tr. sec. of Petiole.
Long sec. Impatiens fulva.
Leaf of Peach.
Arsenic, sublimed.
Scales of Macrotoma.
Ovary of Podophyllum.
Colon of Cat.
Tr. sect. of Stipe.
Arrow-root Starch.
Chestnut Starch.
Flower Stem of Orchid.
Hair of Death's Head Moth.
Oesophagus of Cat.
Scalariform Vessels.
Leaf of Hedeoma pulegioides.
Pollen Oenothera.

Enteromorpha intestinalis.
Leaf of Hippophæ rheumoides.
Peronospora infestans in section of Potato.
Sect. base of Leaf of Sparganum ramosum.
Stomach Passire Congestion of mucous membrane.
Bacillus anthracis in Kidney.
Elytron of Cicindela.
Fibers, Lace Bark, Jamaica, West Indies.
Palate of Litorina.
Lung, Croupous Pneumonia.
Cladophora, stained.
Hairs from Petal of Delphinium.
Tr. sec. Stem of Carex.
Diatoms from Brazil, Moeller.
Diatoms from Kiel, Moeller.
Antennularia, Moeller.
Starch, False Sago, Moeller.
Section of Bean, Moeller.
Spores of Equisetum, Moeller.
Intestine of Man, injected, Moeller.
Navicula lirina, Bourgogne.
Radular membrane of Lingula, Moeller.
Foot of Barnacle (Lepas), Moeller.
Diatoms from Wedal, Moeller.
Diatoms from Honduras, Moeller.
Diatoms from St. Vincent, Moeller.
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Diatoms in Turf from Hammerfest, Moeller.
Membranipora membranacea.
Spiral Vessels from Rheum.
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Nitzschia epithalmoides and Amphiphora latistriata.
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Section of Pine.
Taxodium distichum section, Moeller.
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Section of Cornus, showing lenticles.
Section of Cornus, showing cork layer.
Aristolochia sipho.
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Epithelioma of the Glans Penis.
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Lycopodium spores.
Navicula nobilis.
Fossil Wood section.
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Starch in Cells of Potato, Moeller.
Cucumaria hyndmanii plates, Moeller.
Amphora laevis (Helgoland).
Liver of Toad, injected.
Tr. sec. Thorax of Mouse.
Nailer's Consumption sec. of Lung.
Milk Vessels in Euphorbia, Moeller.
Castor Bean, Tr. sec.
Chara in Fruit.
Cork Cambium in Tr. sec.
Tr. sec. of Stem of Ailanthus glandulosus.
Tr. sec. of Agaric sp., showing spores.
Rhizopus nigricans.
Lg. sec. of Young Sunflower.
Section showing lenticels.
Fucus vesiculosus, Tr. sec.
Tr. sec. Ovary of Erythronium.
Ovary of Calycanthus, Tr. sec.
Vitis Ovaries.
Tr. sec. of Ovary of Sanguinaria.
Tr. sec. of Ovary of Hibiscus.
Tr. sec. of Ovary of Cucumis.
Arisaema triphyllum, Tr. sec. stem.
Ricinus communis, Tr. sec. of hypocotyl.
Starch and Aleurone in sec. of Pea.
Lycopodium, Tr. sec. of root.
Bacillus prodigiosus.
Tr. sec. of Acorus calamus.
Tr. sec. of Stem of Echinocystis lobata.
Volvox globatum.
Robina pseudacacia, Tr. sec.
Tr. sec. of Scilla leaves.
Tradescantia virginica, Tr. sec. leaf and stem.
Lg. sec. of Dodecatheon meadia.
Ovary of Dodecatheon, Lg. sec.
Ovary of Ranunculus.
Tr. sec. of Ovary of Podophyllum.
Tr. sec. of Ovary of Tradescantia.
Lg. sec. of Ovary of Tradescantia.
Dahlia Tuber, showing cryst.
Ovary of Amaryllis.
Corn Smut.
Ascarum Tr. sec. of Ovary.
Protococcus viridis.
Foreleg of Dytiscus Beetle.
Skin of Synapta (spicules in situ).
Neuro fibroma.
Adeno carcinoma.
Adenoma Glandular.
Hard Chancre Penis.
Chondro Sarcoma Femur.
Medullated Neuroma of Face.
Interstitial Nephritis.
Spleen amyloid.
Emphysema.
Cerebellum of Rabbit.
Spinal Cord of Dog.
Bacillus Anthrax, Kidney of Guinea Pig.
Bacillus Anthrax, Spleen of Guinea Pig.
Diatoms, Edible Earth from Java.
Spinal Cord Sclerosis.
Odontophore of Garden Snail, Moeller.
Bugula flagellata, Moeller.
Lithium Carbonate.
Bacillus tetanus (lock-jaw).
White Yeast
Emmerich's Bacillus Culture.
Micrococcus trachoma.
Bacillus Ribbert.
Bacillus of Texas Fever.
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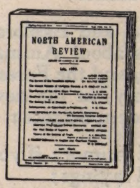

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Journal of
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VOLUME IV. OCTOBER, 1901. NUMBER 10

The Botanical Laboratory and the Botanical Garden of the Tokyo Imperial University, Japan.

The Botanical Laboratory of the Tokyo Imperial University is located in the Botanical Garden, about three-quarters of a mile from the other university buildings. It was removed from the university campus to its present site three years ago. The building is one story high, and consists of two parts which are connected by a covered alley-way.

FIG. 1.—Botanical Laboratory of the Tokyo Imperial University. Front view.

The front part of the double building contains the herbarium, the library, laboratories, and rooms for a professor and three assistants. The second building contains the museum and the lecture room. Here also are more laboratories and a professor's room. In addition, here are found the dark room, the room for the physiological apparatus and chemical balance, the store room, and the room for the incubators, sterilizers, etc. Gas and water are conducted to all working rooms.

The herbarium is well represented with Japanese flowering plants and ferns,

including tropical plants from the islands of Liu-Kiu and Formosa, besides some exotic species. The lower cryptogams, though constantly added to the collection, are yet far from complete.

The library contains the leading English, German, French, and Italian botanical journals. The museum contains both dried and alcoholic specimens of plants for morphological, ecological, and pathological purposes. Some tropical fruits and seeds from Java and Formosa are also found here.

The laboratory is quite well equipped with apparatus and literature for research work in plant physiology. Various important contributions have been made here along this line during the last few years.

A good microtome, Zeiss' microscopes with oil-immersion objectives, afford facility in the study of cytology and embryology. Some good work has also been done along these lines. Among them Mr. Hirase's well known studies on *Ginkgo* should especially be mentioned.

The specimens and literature give facility for the study of systematic botany also. The systematic studies of tropical and subtropical plants from the islands

FIG. 2.—Botanical Laboratory of the Tokyo Imperial University. End view.

of Liu-Kiu and Formosa, and monographic investigations on some difficult phanerogamic group, e. g., *Bambusaceæ*, are the present features along this line in the laboratory.

The apparatus for the study of bacteriology and fermentation is also well provided.

The following lectures and laboratory work are given in this laboratory for undergraduates:

a. Lectures.

1. General botany (morphology and physiology). Three hours a week throughout the year.
2. Systematic botany. Three hours a week throughout the year.
3. Advanced plant physiology. One hour a week during the first term.

b. Laboratory work.

1. Classification, morphology, histology, and embryology. Twelve hours weekly throughout the year.

2. Morphology and histology. Six hours weekly, especially for geology students.
3. Plant physiology. Twelve hours weekly throughout the year.
4. Research work.

There are now six graduates and about fifteen undergraduates studying in this laboratory. It should be noticed here in this connection, that nearly all of the studies in the university are required, and students who specialize in botany are required to study zoölogy, including histology and embryology, geology,

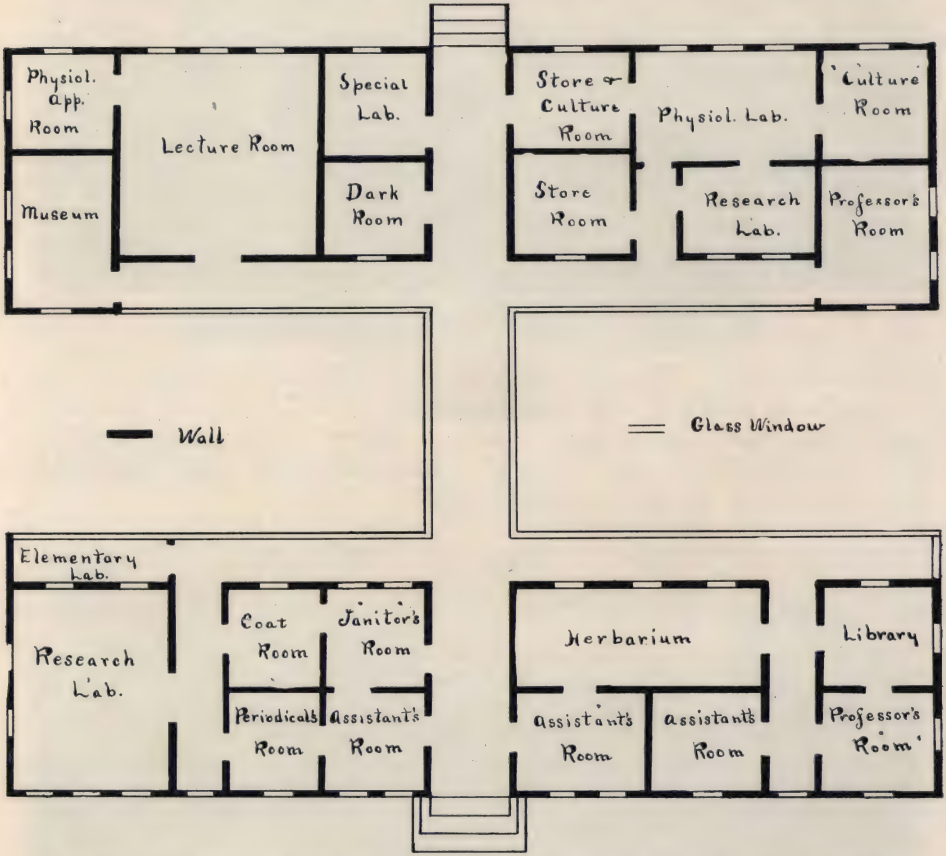

FIG. 3.—Plan of the building of the Botanical Laboratory of the Tokyo Imperial University.

paleontology, mineralogy, physiology, physiological chemistry and bacteriology, besides the above mentioned courses in botany. Only students of botany, zoölogy, and geology come to this laboratory to study. Students of forestry and agriculture pursue their botanical studies at the botanical laboratory in the agricultural college of the university.

The following is the present instructing staff of the botanical laboratory:

Prof. J. Matsumura, professor of botany and the director of the botanical garden. (Systematic botany.)

Prof. M. Miyoshi, professor of botany. (Plant physiology.)

Mr. K. Fujii, assistant. (In charge of morphology and embryology.)
Mr. T. Makino, assistant. (Systematic botany.)
Mr. S. Matsuda, assistant. (Systematic botany.)
Mr. Y. Yabe, assistant, and secretary of the botanical garden.

The Botanical Garden is the great source of living materials for study. It was established in 1681, and was long renowned as the "*O Yaku En*" (garden

FIG. 4—Greenhouse in the Botanical Garden.

of medicinal plants). The area occupied by the garden is more than five acres. The plants are placed in rows according to the natural order, each with labels having Latin and common names. In one quarter of the garden medicinal plants are planted in groups. In the greenhouse the tropical plants from various parts of the world are quite well represented.

FIG. 5.—Cherry trees (*Prunus pseudo-cerasus*) in blossom in the Botanical Garden.

A row of large cherry trees (*Prunus pseudo-cerasus*) with large pink blossoms is a very beautiful sight at the flowering time in April. A few large Ginkgo trees (*Ginkgo biloba*) and several hundred tall bamboos would be a new sight to the Western traveler.

In a part of the Botanical Garden we have a genuine Japanese garden with a pond. In the pond, lotus (*Nelumbo nucifera*), water-lilies (*Nymphæa odorata*, etc.), and several other water plants are growing. It is also a good collecting place for fresh water algæ and planktons. The climbing wistaria (*Wistaria*

chinensis), from which hang purple branches of flowers in May, and plumb trees (*Prunus mume*), renowned for their sweet fragrance of flowers, are found in other corners of the garden.

A large cycas tree (*Cycas revoluta*), several yuccas (*Yucca filamentosa*, *Y. gloriosa*, *Y. aloifolia*), Japanese palms (*Trachycarpus excelsa*, *T. fortunei*), planted in front of the Botanical Laboratory, give quite a tropical aspect to that corner.

FIG. 6.—The lotus (*Nelumbo nucifera*) in the pond of the Botanical Garden.

Of these only cycas is protected from the cold in winter. Japanese banana trees (*Musa basjoo*), which bear no fruit, are planted in groups in one corner of the garden. The plant dies in winter, with the exception of the lower parts of the stem and the root, from which new shoots come out in the spring.

Cornell University. KIICHI MIYAKE.

The Course of Study in Invertebrate Zoölogy in the Marine Biological Laboratory at Wood's Holl.

FIG. 1.—Marine Biological Laboratory at Wood's Holl.

The laboratory in which the course of study in invertebrate zoölogy is given at Wood's Holl is a large room, twenty-eight by fifty-six feet, on the first floor of the south wing of the main building of the Marine Biological Laboratory. The room receives light from the north, west and south sides through eighteen large windows. Directly in front of each window is placed a laboratory table which is arranged to accommodate two students. On the middle of each table is a two shelved rack on which the student finds, in easy reach, a set of the reagents and apparatus he will need for the work of the course. A good arrangement of the reagents and apparatus on the shelves is that given below in the table:

Canada balsam,	Wash bottle,
Clove oil,	Alcohol lamp,
Xylol,	Tincture Iodine,
Cedar Oil,	Acidulated 70 per cent. alcohol,
Absolute alcohol,	Borax-carmine,
95 per cent. alcohol,	Aceto-carmine,
80 per cent. alcohol,	Alum-carmine,
70 per cent. alcohol,	Delafield's hæmatoxylin,
50 per cent. alcohol,	Picro-acetic,
35 per cent. alcohol,	Sublimate acetic,
1 concave watch glass,	10 per cent. nitric acid,
4 Syracuse watch glasses,	Dilute glycerine,
1 black watch glass,	
12 glass slides,	
1 box cover slips,	

One finger bowl, 2 large white dishes, 1 paraffin bottomed tray, 2 pipettes, and a lamp.

The east end of the room has no windows, but is furnished with a blackboard and a chart rack. In addition to blackboard sketches, a set of Leuckart charts were used in illustrating the lectures of the course. In front of the blackboard, a lecture table and several benches are placed. The laboratory is provided with running water, both salt and fresh, and in the middle of the room there are a number of large aquaria. When practical, these aquaria were supplied with the animals being studied, thus giving the student the opportunity of seeing the living animal under more or less normal conditions. Considerable stress was laid on this part of the work and twice each week excursions were made to various localities for the purpose of seeing the animals at home. On

some of these excursions digging and shallow water collecting was the object. In others, dredges were used in deeper water. On one afternoon the class accepted the invitation from Dr. H. M. Smith of the U. S. Fish Commission, to go on a dredging trip on the Steamer "Fish Hawk" and had the privilege of seeing how dredging is done by means of the most efficient and up-to-date apparatus.

The course of study covered six weeks, beginning July 3d, and ending August 13th. It consisted in both lectures and laboratory work. The lectures, which were given daily, from 9 to 10 a. m., by the instructors, had for their subject matter the natural history, classification, anatomy and development of the animals or groups of animals to be studied in the laboratory during the day. The instructor who gave the morning lecture had charge of the laboratory work which followed. In this he was assisted by two other instructors. He had

FIG. 2.—General Laboratory.

selected the forms for study and was responsible for their collection and preparation for the students. He had, with a few exceptions, prepared the laboratory outlines which were used by the students in their studies and dissections. For a few forms Bumpus' "Invertebrate Zoölogy" was used.

In addition to these elementary lectures by the instructors it was intended that each day's work should close with a lecture by an investigator of the group being studied on some subject in which he is interested relating to the group. This plan was given up for two reasons, the investigators were either not at Wood's Holl or were unwilling to lecture, and at 4 o'clock the greater part of the students wanted to go bathing. Those lectures which had been promised, before the course began, were given—the three by Professor C. O. Whitman

on " Metameric Segmentation," at the originally planned hour, 4 p. m., but the three lectures by Dr. G. N. Calkins on the " Protozoa " and three by Prof. G. H. Parker on the " Sense Organs of the Crustacea " were given in the evening at the general lecture hall.

The laboratory work of the day was divided into two periods of two hours each, the first from 10 a. m. to 12 m., the second from 2 to 4 p. m. During these periods it was the duty of three instructors to be in the laboratory for the purpose of distributing material to the students and to answer such questions as they might be asked concerning the work of the day. Besides these regular working hours the laboratory was open at all times to the students and many of them took the opportunity to carry further the work begun in the course or to work along lines in which they were especially interested. The work in the laboratory consisted chiefly in gross dissections and microscopical studies but some

FIG. 3.—Private Laboratory.

work was given in killing, staining and mounting small animals and in mounting and interpreting serial sections. Each student furnished his own dissecting instruments, drawing materials and microscope. In many cases the microscopes were owned by the students, but in others they were rented for the course from the Bausch & Lomb agency. For a rental of five dollars a student was provided with a B.B. stand furnished with an Abbe Condenser, two eyepieces and two objectives.

Students were advised to make accurate drawings of what they saw, and in case the work was to be substituted in their college course such drawings were required.

The table which follows will give a better idea of the actual work done in the course and the manner of conducting it, than could be gotten from a lengthy description.

DATE	DAY	GROUP	LECTURER	LABORATORY ASSISTANTS	FIRST PERIOD WORK	SECOND PERIOD WORK
July 3	Wed.	Protozoa	Dr. Hall	Entire Staff	Amœba, Paramœcium,	Spirostomum
" 4	Thur.					Excursion to Ram Island
" 5	Fri.	"	"	" "	Vorticella, Euglena, Gonium,	Pandorina, Gregarina
" 6	Sat.	Porifera	Dr. Grave	McGregor Drew	Grantia	Grantia
" 7	Sun.					
" 8	Mon.	Cœlenterata	Mr. Budington	" "	Hydra	Obelia
" 9	Tues.	"	"	" "	Gonionemis	Metridium
" 10	Wed.	"	"	Hall "	Metridium	Excursion to Vineyard Haven
" 11	Thur.	"	"	" "	Aurelia	Eudendrium
" 12	Fri.	Platyhelminthes	Dr. Grave	" "	Planocera, Planaria	Bdelloura
" 13	Sat.				EXCURSION TO	KETTLE COVE
" 14	Sun.					
" 15	Mon.	"	"	Budington "	Distomum	Crossobothrium
" 16	Tues.	Annelida	Dr. McGregor	Hall "	Nereis	Nereis
" 17	Wed.	"	"	Budington "	Nereis	Excursion to Hadley Harbor
" 18	Thur.	"	"	" "	Sipunculus	Brachionus
" 19	Fri.	Polyzoa	Dr. Drew	Mc Gregor Grave	Bugula	Plumatella
" 20	Sat.				EXCURSION TO N	ORTH FALMOUTH
" 21	Sun.					
" 22	Mon.	Echinodermata	Dr. Grave	Hall Drew	Asterias	Asterias
" 23	Tues.	"	"	Budington "	Arbacia	Arbacia
" 24	Wed.	"	"	McGregor "	Thyone	Took towings
" 25	Thur.	Mollusca	Dr. Drew	Budington Hall	Chiton, Venus	Venus
" 26	Fri.	"	"	" "	Venus	Venus
" 27	Sat.				EXCURSION TO PE	NAKESE ISLAND
" 28	Sun.					
" 29	Mon.	"	"	" Grave	Sycotypus	Sycotypus
" 30	Tues.	"	"	" "	Sycotypus	Sycotypus
" 31	Wed.	"	"	McGregor "	Loligo	Dredged off Nobsque
Aug. 1	Thur.	"	"	" "	Loligo	Loligo
" 2	Fri.	Arthropoda	Dr. Hall	" Drew	Lobster	Lobster
" 3	Sat.				VISITED PROFESSOR	WHITMANS' PIDGEONS
" 4	Sun.					
" 5	Mon.	"	"	Budington "	Lobster	Lobster
" 6	Tues.	"	"	" "	Crab	Hippa
" 7	Wed.	"	"	Grave "	Talorchestia, Cyclops.	Rain, no Excursion
" 8	Thur.	Tunicata	Dr. McGregor	" "	Molgula	Molgula
" 9	Fri.	"	"	" "	Perophora, Botryllus Appendicularia, Salpa	Dredged on " Fish Hawk "
" 10	Sat.					
" 11	Sun.					
" 12	Mon.	Vertebrata	"	Hall "	Skate	Skate
" 13	Tues.	"	"	" "	Skate	

Outline of work for the summer session of the Marine Biological Laboratory at Wood's Holl.

Of the thirty-one students who attended the course, this year about one-half were teachers. The other half was made up of students who were either making credits in their regular college work or who were preparing for a course in medicine. One practicing physician took the course. A few who took the work had come to Wood's Holl for the Nature course which was not given this year.

After the work of the day the instructors met for a short time in the director's room and went over the work next to be given. Difficult points were demonstrated by the instructor who would be in charge of the work and methods of presenting the subject were discussed.

Formerly, at the time each group was being taken up, an investigator, especially interested in the group but not otherwise interested in the course, has been invited to lecture on his specialty before the class. The duty of the instructors was only to assist in the laboratory work, while the director in charge of the course was responsible for the selection of the types to be studied and for the manner in which each group was presented to the students. While this method may be the theoretically ideal way of introducing students to the study of zoölogy it is lacking in practice in some important respects; it is not always possible to get investigators of certain groups of animals to lecture at the time the lectures are needed, and often the work goes on without lectures. Investigators, not knowing the students to whom they are lecturing, nor the work they have done, often fail to present their subjects in the best manner possible. It was to ensure a coördination between lectures and laboratory work, and lectures adapted to beginning students, that the director this year, Dr. G. A. Drew, not only asked each instructor to give the lectures on certain groups but to take charge of the laboratory work on the same.

The success of the plan was to be seen in the active interest of the students in their work which continued throughout the course. Very little *cutting* was done and on the last day twenty-eight of the thirty-one students who began the course reported for work.

CASWELL GRAVE.
Johns Hopkins University.

Botany at the Biological Laboratory at Wood's Holl.

BOTANICAL STAFF.

BRADLEY MOORE DAVIS,	Instructor in Botany, University of Chicago.
GEORGE T. MOORE,	Instructor in Botany, Dartmouth College.
RODNEY H. TRUE,	Lecturer at Harvard University.
CHARLES H. SHAW,	Professor of Botany, The Temple College.
ANSTRUTHER A. LAWSON,	Fellow in Botany, University of Chicago.
LILLIAN G. MACRAE,	Curator and Collector in Botany.

Developments, such as have in recent years taken place at Wood's Holl in physiology and in botany, afford illustrations of the all-embracing love of knowledge so characteristic of this unique station by the sea, the Mecca of American biology. More than ever, during the past season, botany has made itself felt as a live and considerable part of the laboratory. The building was full to the last table. On the upper floor were assembled the workers in cryptogamic botany under Dr. Davis and Dr. Moore. These were divided into three groups, those

devoting the whole session to the algæ, those working throughout on the fungi, and those who divided the time between the two classes.

The wetness of the season brought on an abundant supply of fungi; twenty-six species of myxomycetes alone were found. Expeditions near and far brought to the laboratory tanks, also, the usual rich assortment of algæ.

The lower floor was occupied by two classes—in physiology and in ecology, respectively. The former reached a circle much larger than the class, many zoölogists and other workers attending the lectures. The ecology people spent much of their time in the field, and made the beginning of an ecological survey of the vicinity. At the close of the term many members joined in a botanizing party to the White Mountains.

Year by year the work in botany will take new steps forward, and seeking ever to turn the students in the direction of research, it may well do its share in upholding the Marine Laboratory ideal of productive scholarship.

Temple College, Philadelphia, Pa. C. H. Shaw.

LABORATORY PHOTOGRAPHY.

Devoted to methods and apparatus for converting an object into an illustration.

THE ORTOL DEVELOPER.

It may be of some interest to the readers of the Journal who are interested in laboratory photography to be put in touch with one of the best all around developers.

Fig. 1.—Viscera of Frog.

After using the various developers put on the market, with various degrees of success, I have at last struck upon one which fulfills all of my requirements. This salt goes by the name of Ortol, and is purchased in sealed tubes with an accompanying cartridge of the required amount of soda. The contents of each are dissolved in 20 oz. of water and kept in separate bottles.

Various grades of intensity may be gotten by regulating the strength of the solution and by the use of more or less soda as occasion requires. In Fig. 1 the development was carried slightly too far, but shows great contrast and clearness. In the second illustration we have a transverse section of the human sciatic nerve developed for detail rather than contrast.

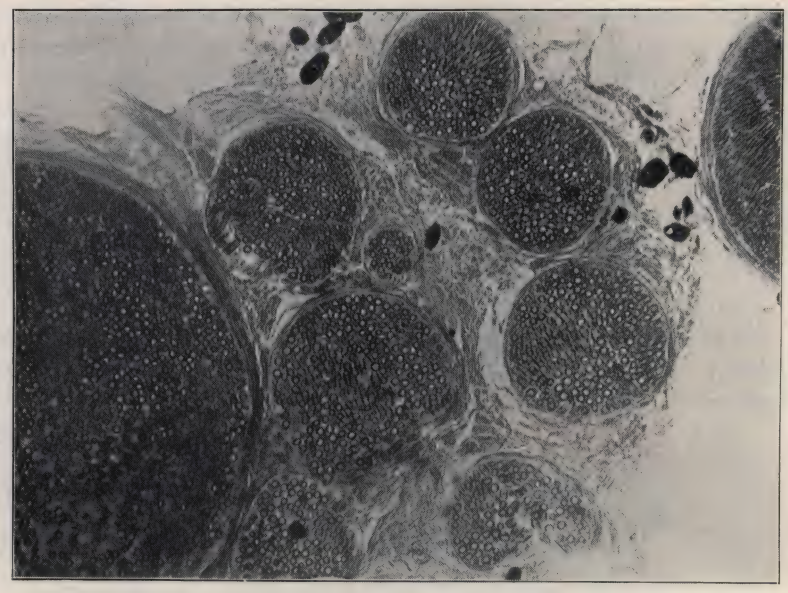

FIG. 2.—Transverse section of human sciatic nerve.

The following proportions may be varied somewhat according to exposure, but I have found them to answer for all purposes by using more or less bromide:

For negatives:

Ortol,	- - - -	2 parts stock solution,
Soda,	- - - -	2 " " "
Water,	- - - -	4 "

For lantern slides:

Ortol,	- - - -	2 parts stock solution,
Soda,	- - - -	1 part " "
Water,	- - - -	3 parts.

For bromide papers:

Ortol,	- - - -	1 part stock solution,
Soda,	- - - -	1 " " "
Water,	- - - -	8 parts.

I do not believe any definite rule can be set down as to just how much

bromide shall be used, this being regulated by the judgment and experience of the operator. I have found it very convenient to use none at all in some cases, and again in others to stop the developer back so that an image will not appear in less than six or eight minutes.

When working for extreme contrast, as in reproducing book illustrations, mechanical diagrams, etc., a plate sensitized specially for this purpose is absolutely necessary. Such a plate is manufactured by the G. Cramer Dry Plate Co. of St. Louis, and may be obtained of any dealer in photo supplies. They are rather slow in their action and must be given a longer exposure than ordinary.

For development, the solution must be as strong as possible and well stopped back. I usually make up the developing solution in 200 c. c. quantities, "enough to conveniently fill a 5x7 tray," after the following formula:

Ortol,	- - -	75 c. c.	stock solution,
Soda,	- - -	100 c. c.	" "
Bromide, 10 per cent, sol.,		25 c. c.	

After exposure, the plates should be brushed off and immersed in the developer, when the image will flash up rather quickly, and stand out in very strong contrast with the black background; but do not remove until the entire plate is perfectly black, even when held up to the red light, then pass it into acid fixing bath. The black background will be found to be perfectly opaque, even if held up to the sun, while the lines will stand out perfectly transparent.

Should any of my readers start using Ortol, I feel fully satisfied that it will be some time before they change again. R. P. WOODFORD.

Contributions to Our Knowledge of Color in Photo-micrography.*

One of the most perplexing and as yet unsolved problems of Photo-micrography is that of color values, i. e., how to reproduce natural colors by means of the sensitive plate. Of the plates now in use, the orthochromatic approaches most nearly the ideal color plate; yet this is not perfectly satisfactory, as it does not give sufficient contrast.

The investigations which form the basis of this article were undertaken to determine the relative merit of various photographic plates. The apparatus, as illustrated in Fig. 1, consists of a direct vision spectroscope so mounted in the front board of an ordinary camera (with lenses removed) that the spectrum, when projected on the plate, will come in the center horizontally and at the top of the plate. The back of the camera is constructed in such manner as to allow of its being moved in the vertical plane, thus making it possible for one to make four exposures on the same plate, and by so doing to make an accurate comparison between them.

The plates examined may be grouped according to their degree of perfection as follows:

Group I—Characterized by a very high degree of sensitiveness a little above

* F. L. Richardson. Journal of the Boston Society of Medical Sciences, **5**: 460–464.

line D, falling off abruptly on either end, and only slightly sensitive to the greens and blues.

Group II—Characterized by two distinct maxima—one a little above the

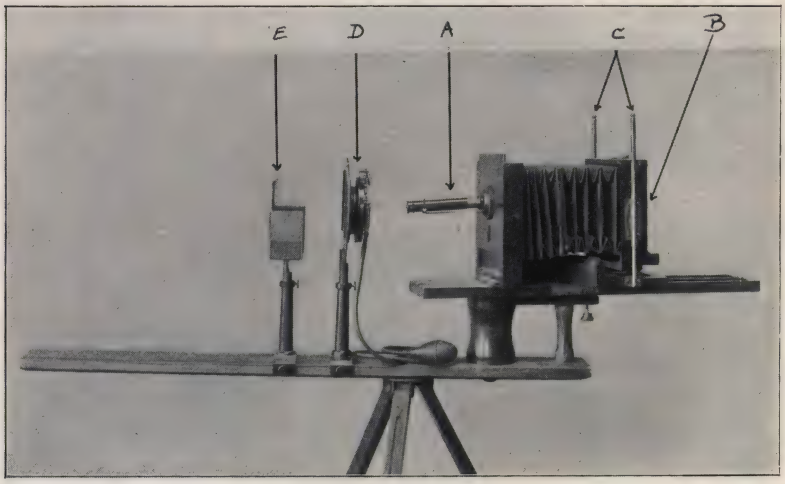

Fig. 1.

Apparatus for making spectrographs. A. Spectroscope. B. Back of camera, carrying screen and plate-holder. C. Supports upon which the back (B) may be moved. D. Shutter. E. Color screen in color screen holder.

D line, and the other in the blue-green. Between these two maxima the sensitiveness falls very considerably.

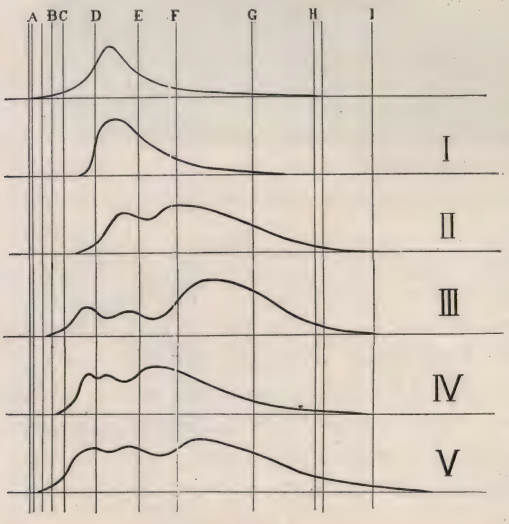

Fig. 2.

Explanation to Figure.—The upper curve shows the visual intensity of the spectrum (from Fraunhofer). Curves I–V represent the photographic intensity of the spectrum taken on plates from group of corresponding number. GROUP I—Cramer isochromatic (slow). GROUP II—Standard orthochromatic (slow); Forbes orthochromatic (slow); Carbutt orthochromatic (slow); Otto Perutz. GROUP III—Lovell color-differentiating; American spectrum plate. GROUP IV—Cadett & Neal spectrum plate (slow). GROUP V—International "Erethro."

Group III—Characterized by having its maximum sensitiveness in the blue (as with ordinary plates), with lesser bands of sensitiveness extending below the D line.

Group IV—Characterized by bands of sensitiveness extending below line D, with greatest intensity in the yellow-green, and falling off at the violet end before H_2.

Group V—This group most nearly approaches perfection. It is characterized by a sensitive band well below line D, and somewhat below the red end of Groups III and IV. This plate gives an almost uniform degree of sensitiveness with a maximum intensity in the green.

If sensitiveness to the spec-

trum were the only feature to be considered in the selection of a plate for photo-micrographic work, a plate from Group V would be chosen, but the general working of the plate as well as the keeping qualities are factors that must be considered. For practical work and keeping qualities the author found the Cadett & Neal Special Slow Spectrum Plate of Group IV most satisfactory, and used it in the preparation of the spectrographs illustrated in Fig. 3.

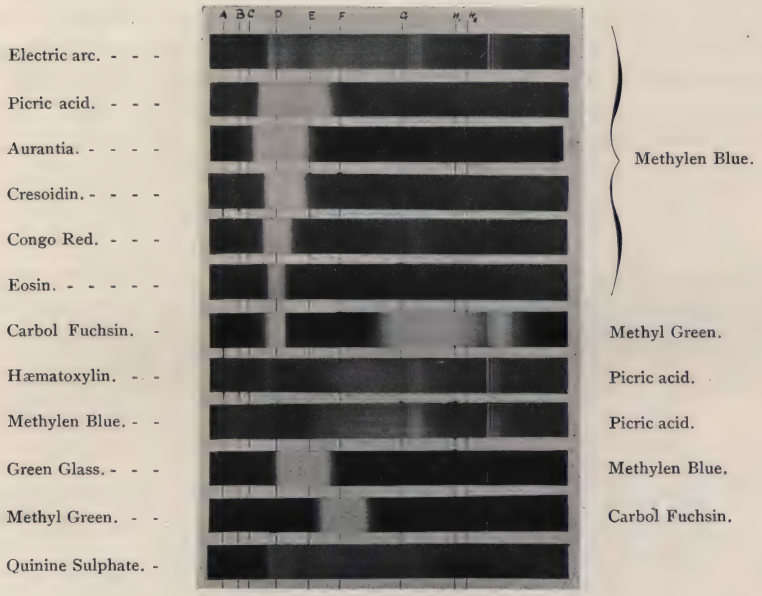

Fig. 3.

Explanation to Plate.—This plate is a reproduction of spectrographic analyses of some of the common stains. The red end of the spectrum is on the left. The principal Fraunhofer's lines are marked. The name of the stain is on the left, while on the right is the name of the proper screen to use to increase the photographic intensity. To decrease the contrast use a screen of the same color as the stain.

The perfect photo-micrographic plate would give equal photographic intensity to all the colors of the visual spectrum, but since this degree of excellence has not been attained, the value of a given plate may be enhanced by the use of color screens, or ray filters, which serve to increase or decrease the photographic intensity of a color. The following are the laws upon which the use of color screens is based:

First. To increase the photographic intensity of a color, a screen of complementary color should be used.

Second. To decrease the photographic intensity of a color, a screen of the same color should be used.

These laws hold good for all branches of photography, whether by transmitted or reflected light, and are not dependent upon the position of the screen, i. e., whether the screen is placed between the source of illumination and the object, between the object and the objective lens, or between the lens and the plate.

In determining the photographic complement of a color it is more accurate to make photographic analyses of stains and color screens than to make simple visual analyses.

The same plate and source of light must be used as in taking the photo-micrograph, because, as shown above, plates of different makes may differ greatly in their degree of sensitiveness to different parts of the spectrum, and it is a well recognized fact that different illuminating agents give different spectra. The object for which one should strive in the analyses of stains and color screens is to imitate as exactly as possible the conditions that will exist in the process of photo-micrography. The spectrographs illustrated in Fig. 3 were made with color screens in preference to cells of fluid, as the screens are much more convenient than cells, and are quite as satisfactory. The color screens are made by soaking a cleared lantern slide in a solution of the desired stain until the gelatin is saturated, then rinsing and removing the surface liquid with a cotton pad. The screen is then dried and covered with a cover-glass as in mounting a lantern slide. The depth of color in these screens is dependent upon the degree of concentration of the staining solution rather than upon the length of time the plate is soaked. C. W. J.

Kresylechtviolett.

In the Centralblatt für Bakteriologie, Vol. 27, Homberger describes a new method of staining the Gonococcus by which it may be distinguished from all other micro-organisms. The stain used for this purpose was Kresylechtviolett, a fluorescing color prepared by Leonhard. In dilutions of 1–10,000 the water solution of this stain colors the Gonococcus a reddish violet while other micro-organisms are either not stained at all or take a faint blue tinge. Homberger mentions further that mast-cells, amyloid, mucin and colloid are stained well with this dye and that it can also be used in Gram's method.

It was found on working with the stain in this laboratory that the water solutions precipitate on standing and lose their staining power. The alcoholic solutions did not precipitate, but satisfactory results could not be obtained with them. Since the reactions obtained with the stain were found by repeated experiment to be very characteristic, and as it promised to be a very valuable addition to diagnostic methods the present work was undertaken at the request of Dr. Warthin to find, if possible, a satisfactory method of using the stain, and to extend its application in pathological work.

The stain used was prepared by Grübler. It is soluble in water and alcohol. After much experimental work the following method of preparation was found to be satisfactory in all respects, and to meet all requirements, and is the one used throughout this work:

Preparation (Morse):

Five per cent. aqueous solution of Phenol, -	80 c. c.
Ninety-five per cent. Ethyl Alcohol, - - -	20 c. c.
Stain, - - - - - - - - -	1 gm.

Mix the two solutions, then add the stain, stirring thoroughly. As soon as the stain is all dissolved, filter. This solution keeps well, gives all the staining reactions, and may be diluted to any degree with distilled water without causing precipitation. The above method of preparation must, however, be rigidly followed.

Tissue may be fixed in any way, but formalin, mercuric chloride, and Zenker's give the best results in the order named. Paraffin or celloidin embedding may be used. Excellent results may be obtained by the combination plate-method.

Staining method (Morse):

1. Stain 1–5 minutes.
2. Wash thoroughly in distilled water.
3. Blot with filter paper.
4. Anilin-Xylol (2:1).
5. Pure Xylol.
6. Balsam.

This method is the best one for the reactions with the majority of pathological substances. The variations of this method for certain specific reactions will be mentioned below. Nearly all the tissues of the body and the important pathological conditions have been worked over with this stain. Its most important applications are as follows:

For use as a simple nuclear stain it is best to stain only two minutes, then wash and differentiate in alcohol. A contrast stain is not necessary, as the deep violet color of the nuclei is easily distinguished from the pale blue tint given to other structures. Eosin may, however, be used after the sections have been stained and differentiated in alcohol.

Blood smears give the best results when fixed as for tri-acid staining. Heat fixation gives the best result. When stained for two minutes the red cells are a light yellowish green, the protoplasm of the leucocytes colorless, and the nuclei rose-pink. Blood-plates and basophile granules stain like the nuclei. The malarial plasmodium stains a dull pink, not as deep as the leucocyte nucleus, and is easily distinguished. In well fixed tissue sections blood stains similarly, but the basophile granules do not show.

The nuclei of young connective tissue stain a light purple, while the intercellular substance takes a dull rose pink; in old connective tissue the nuclei stain a deep violet or purple, while the intercellular substance does not stain at all or takes a very light violet.

Yellow elastic tissue stains a sky blue. It is best brought out by longer staining.

Voluntary muscle stains a pale green with violet nuclei, the protoplasm of involuntary muscle a light purple to a light blue with nuclei of a darker shade.

Nerve cells and axis cylinders stain purple, the nuclei violet, the granules of the cell body are very distinctly shown. Neuroglia stains a very light purple, or not at all.

Fibrin stains a bluish purple, but this reaction is not distinctive.

Hyalin in corpora fibrosa does not stain at all or takes faint blue tint.

Colloid takes a deep indigo blue, which is very characteristic.

Calcification takes a dirty, cold blue, which can be readily distinguished from colloid.

Cartilage takes a reddish violet, which is very characteristic.

Corpora amylacea also stain a reddish violet.

The most valuable reactions with this stain are those with mucin, amyloid, mast-cells, and the so-called cancer parasite. In staining for these the sections should be dehydrated in alcohol and cleared in turpentine. The excess of turpentine must be thoroughly blotted off before mounting in balsam, else the stain will run and the specimens become blotchy.

The reaction with amyloid as brought out by the method given above is very striking and characteristic, and is particularly valuable in teaching work. The amyloid stains a ruby red, which is sharply contrasted with the clear blue nuclei and faint blue protoplasm of the living tissues. No other method brings out so well the presence and location of small quantities of amyloid. The stain appears also to give a permanent reaction; in the ten months in which this stain has been used in this laboratory no fading of properly prepared specimens has been observed, and trial specimens exposed daily to sunlight have retained their color for months. The apparent permanency and clearness of this reaction, as well as the fact that the sections so treated can be preserved in balsam, gives this stain a high place over the anilin dyes usually employed for amyloid reactions.

Mucin stains a bright rose pink, which is very characteristic and brings out the presence of mucin when the amounts are too small to be demonstrated by other methods. It also distinguishes mucin from pseudomucin, the latter either not staining at all or taking a very light blue tint.

The method is also a most excellent one for the staining of mast-cells. The best results are obtained by staining only ten seconds, washing thoroughly and differentiating in alcohol. The nucleus stains a light violet, the granules a fuchsin red.

The so-called cancer parasite stains a rose pink, and may be seen as a point in the protoplasm of the cell or as a slightly larger mass surrounded by a clear zone containing radiating lines. A more advanced stage is seen as a reticular mass replacing more or less of the cell protoplasm, and, in some instances, continuous with the mucin surrounding the cell nests. The resemblance to the reaction with mucin may be noticed in passing.

The specific reaction with the Gonococcus has already been mentioned. This stain has, however, the further advantage in that the material may be stained in the hanging drop and the life of the cell not destroyed, so that the movements of the leucocyte containing the micro-organisms may be studied.

From these investigations it seems that for ease of manipulation, wide application and specific staining reactions Kresylechtviolett holds a very high place among differential stains for diagnostic purposes, and that it is a most valuable addition to the resources of the teaching laboratory.

Pathological Laboratory, University of Michigan. RALPH L. MORSE.

MICRO-CHEMICAL ANALYSIS.

XVII.

MAGNESIUM GROUP—SEPARATIONS.

When engaged upon the examination of a complex mixture of unknown composition, the chemical behavior of all the elements and salts liable to be present must ever be borne in mind. It is seldom indeed that the analyst is called upon to make an analysis of a substance or mixture of absolutely unknown composition. The chief constituents are almost always known, or at least suspected; and there are also always good reasons why certain other substances cannot be present. He who would become a rapid worker must learn to reason by exclusion, but the beginner must realize that there is a vast difference between using one's judgment and common sense, and hazarding a mere guess. Thus the choice of methods in micro-chemical work will depend as largely upon what substances are *absent* as upon what are present.

In all analytical work rapidity is to be striven for, but such rapidity must never be gained at the expense of accuracy.

In order to better understand the chemistry of the separation methods of this group, it may be well to recall the most important of the chemical properties of the elements composing it, upon which our procedures will depend.

The hydroxides of all the members of the group are insoluble in pure water.

Glucinum hydroxide is insoluble in excess of ammonium hydroxide, but is soluble in ammonium carbonate, potassium hydroxide, and sodium hydroxide.

Magnesium hydroxide is soluble in the presence of ammonium salts, especially ammonium chloride, but is insoluble in excess of the fixed alkalies.

Zinc hydroxide behaves like that of glucinum toward fixed alkalies, but unlike glucinum, it is also soluble in ammonium hydroxide.

Cadmium hydroxide is insoluble in excess of sodium or potassium hydroxides, but is soluble in ammonium hydroxide.

Magnesium is the only one of the group normally yielding a crystalline precipitate with secondary sodium phosphate in ammoniacal solution.

Zinc and cadmium are readily precipitated by oxalic acid, glucinum with difficulty, and magnesium only when much acetic acid is present or the solution is excessively concentrated. In the case of glucinum, the double potassium oxalate is less soluble than the normal oxalate.

All four elements are precipitated by alkaline carbonates.

The chlorides and oxides of zinc and cadmium can be easily volatilized.

Zinc and Cadmium from Magnesium, etc., by sublimation.

A. Place a small portion of the material on a nickel or platinum spatula,* moisten with nitric acid, evaporate gently, then ignite to convert into oxides, but

* This Journal, III, p. 794, Fig. 6.

avoid their volatilization. Convert into chlorides by evaporating repeatedly with hydrochloric acid. When perfectly dry, the flame is moved nearer and nearer the substance and a glass slide bearing on its upper side a drop of water** is held directly over the substance being tested. If a sublimate results it may consist of $ZnCl_2$, $CdCl_2$, $BiCl_3$, $PbCl_2$, $FeCl_3$, $CuCl_2$, and perhaps $HgCl_2$. Any arsenic, antimony and probably all the mercury which might have been present will have been driven off in the ignition of the nitrates to oxides.

Dissolve the sublimate in a drop of water and test with ammonium mercuric sulphocyanate. In the event of the sublimate being complex, add water to remove the bismuth. Decant. Remove the lead by sulphuric acid. Add sodium hydroxide, cadmium and iron are precipitated and zinc passes into solution. Dissolve the precipitate in dilute acid and test for cadmium. To the sodium hydroxide solution add ammonium carbonate and examine the preparation for the double carbonate of zinc and sodium.

When much copper is present it is always best to first remove it by placing a drop of a solution of the substance on metallic iron, thus causing it to separate.

B. The oxides of zinc and cadmium can be sublimed on charcoal before the blowpipe. Make a slight depression in the carbon, place in it a moderate quantity of the material, moisten with water and heat gently till dry, then strongly with the *oxidizing* flame, holding the coal at an angle. Zinc oxide forms a coating on the charcoal, yellow while hot, pure white when cold. Cadmium oxide yields a brown variegated coating. The film on the charcoal is removed by carefully scraping with the spatula, transferred to a slide, heated with dilute acid and the clear liquid drawn off from the residue of carbon. The solution is then tested for zinc and cadmium.

In addition to zinc and cadmium, films on charcoal are given by antimony, tin, bismuth, lead, and rarely by arsenic and mercury.

Removal of Phosphates.

If phosphates are present in the substance to be tested, it is often necessary to first remove them before any reliable tests can be obtained for magnesium and glucinum. One of the simplest methods of procedure is as follows:

Add strong nitric acid, then a few small strips of thin, pure tin foil or a little powdered tin. Boil until all the tin has been converted into the oxide and phosphate; draw off or filter, and repeat the process until no test for phosphoric acid is obtained with ammonium molybdate. The solution is now evaporated to dryness, and if arsenates are also present, the residue is ignited to drive off any arsenous acid which may have resulted from any reducing action of the metallic tin. The residue is extracted with water acidified with nitric acid and tested as given below.

The removal of phosphoric acid by metallic tin is simple, expeditious and satisfactory. Only a few cautions are necessary. The nitric acid must be strong acid, the size of the drop, and the amount of tin added must correspond

** This Journal, III, pp. 857–858.

to the amount of phosphoric acid present; that is, when there is a large amount the drop must be large, so as to permit of sufficient heating. It is better under such conditions to employ two operations to remove the phosphates rather than attempt it in a single one. A small test tube will generally prove more satisfactory than a slide or watch glass.

GLUCINUM.

A. Glucinum in Simple Substances.

Add ammonium hydroxide and ammonium carbonate (see page 1328) in excess, glucinum hydroxide is dissolved (also U, Zn, Cd, and perhaps Mg). Decant or filter, and to the solution add ammonium chloride in moderate amount, evaporate, and ignite gently until all ammonium salts are removed. The residue is dissolved in dilute sulphuric acid, a little sodium acetate and a trace of mercuric chloride added. The preparation is then tested for glucinum with potassium oxalate. Or, treat the residue with uranyl acetate and sodium acetate. In the latter case Mg, Zn, Cd must be absent.

B. Glucinum from Magnesium.

Add to the solution sodium hydroxide, warm, evaporate and take up with water. Magnesium hydroxide is precipitated, the glucinum passes into solution (also Zn and Al).

Wash the precipitate and treat it with ammonium chloride, the magnesium passes into solution and is tested with sodium phosphate and ammonium hydroxide.

The solution containing the glucinum is evaporated, extracted with hydrochloric acid and tested with potassium oxalate.

C. Glucinum in Complex Mixtures.

Remove any copper, etc., by iron foil.

Add ammonium hydroxide and hydrogen peroxide. Warm for a time, then evaporate. Repeat the treatment. Extract the residue with a solution of ammonium carbonate. Fe, Mn, Co, Al and part of the Mg should remain insoluble, while Gl, Zn, U, Mg will be dissolved. The solution is evaporated, ignited, dissolved in dilute acid and tested with potassium oxalate; or if much magnesium is present, separate with sodium hydroxide as in *B*.

MAGNESIUM.

A. Magnesium from Glucinum, Zinc, Cadmium, Aluminum.

Precipitate with sodium hydroxide, warm, evaporate, and extract repeatedly with water. Mg and Cd remain behind. Dissolve the residue in hydrochloric acid and divide into two portions. Test one part for magnesium with sodium phosphate, and the other for cadmium with sulphocyanate or oxalic acid.

B. Magnesium in Complex Mixtures.

Add ammonium chloride and ammonium hydroxide in slight excess, then hydrogen peroxide, and warm. Evaporate and treat again. Extract the residue

with a dilute solution of ammonium hydroxide; Mg, Zn, Cd, Ni, Cu are dissolved. To the solution add oxalic acid and acetic acid and from the precipitated oxalates of Zn, Cd, Ni, and Cu, the clear solution is separated by decantation, filtration, or the centrifuge. This solution is evaporated with sulphuric acid and heated to destroy the oxalic acid. The residue is dissolved in acidulated water, treated with sodium hydroxide, the precipitate carefully washed, dissolved in hydrochloric acid and tested for magnesium with sodium phosphate.

C. Magnesium from Glucinum.

To the solution to be tested add ammonium chloride, then carefully, a little at a time, ammonium hydroxide as long as a precipitate results, draw off at once and test the decanted solution with sodium phosphate for magnesium.

ZINC.

A. Zinc from Glucinum, Magnesium, and Cadmium.

Ignite, warm gently with sodium hydroxide solution. Zinc and glucinum are dissolved, magnesium and cadmium remain in the residue. Separate the solution, add to it acetic acid and precipitate the glucinum with potassium oxalate (a little zinc is always precipitated with the glucinum). Separate the clear solution, evaporate and destroy the oxalic acid by means of sulphuric acid and heat. Take up the residue with water, acidified if necessary, add ammonium acetate, and test for zinc with sulphocyanate; the addition of a trace of copper will increase the delicacy of the reaction. Or, instead of testing with sulphocyanate, to the sodium hydroxide solution after the removal of the magnesium and cadmium, add ammonium carbonate, zinc will separate as the double carbonate of zinc and sodium.

B. Zinc from Cadmium.

Precipitate with primary sodium carbonate in ammoniacal solution, cadmium separates at once, draw off the supernatant solution and allow to stand for a short time, zinc separates as the double carbonate. Or, acidify the solution to be tested, and to it add powdered metallic magnesium. Zinc and cadmium are precipitated. Wash carefully the finely divided metallic mass; add acetic acid, heat the preparation; zinc passes into solution with but very little cadmium, decant and test for zinc. The residual metallic cadmium is dissolved in hydrochloric acid and tested.

C. Zinc in Complex Mixtures.

Treat with ammonium hydroxide and hydrogen peroxide. Then with ammonium carbonate. To the decanted solution add oxalic acid and acetic acid. Separate the precipitated oxalates, ignite and extract the zinc with sodium hydroxide. The clear solution containing the zinc is heated with ammonium chloride and tested for zinc with primary sodium carbonate or acidified and tested with sulphocyanate.

CADMIUM.

A. Cadmium from Magnesium.

The bulk of the magnesium can be precipitated as magnesium ammonium phosphate by adding ammonium hydroxide and sodium phosphate, the latter very carefully and only a very little at a time so as to avoid precipitating any cadmium. The clear supernatant solution is then drawn off and tested for cadmium.

B. Cadmium from Glucinum, Zinc, or Aluminum.

Precipitate with excess of sodium or potassium hydroxide. Glucinum, zinc, and aluminum are dissolved. Cadmium remains insoluble. Dissolve the precipitate in hydrochloric acid and test with oxalic acid or with sulphocyanate.

C. Cadmium in Complex Mixtures.

Proceed as in the above described methods in which ammonium hydroxide and ammonium carbonate, etc.; e. g., *Zinc C.* After precipitation and ignition of the oxalates, the residue is extracted with sodium hydroxide, cadmium remains insoluble. This residue insoluble in sodium hydroxide is washed, dissolved in hydrochloric acid, and tested for cadmium.

D. Cadmium from Zinc.

See *Zinc B.*

E. M. CHAMOT.

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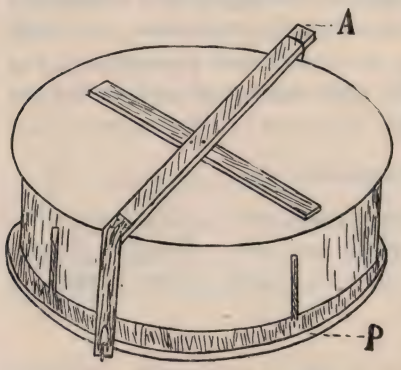
A Damp Chamber for Use on the Klinostat.

Students of Plant Physiology have often found need for a damp chamber for use on the klinostat which will furnish a firm support for seedlings in rapid rotation and will retain a supply of moisture for several hours. The original method used by Knight has been variously modified so as to provide moisture for the plants. In cases where the desired plane of rotation is horizontal the experiment may be successfully performed by covering with a bell-jar a rotating disk whose axis projects below the table and to which the motive power is applied. In work where the desired plane of rotation is vertical, some experimenters have arranged a reservoir of water so that the supply of moisture falls upon the rotating seedlings in drops; but here is a chance that the thigmotropic or traumotropic stimulus given by the falling drops may affect the results of the experiment.

The apparatus described below has been successfully used for different kinds of work in the Botanical Laboratory of the University of Michigan.

A narrow board, containing about eight pegs 5 or 6 cm. long, is fitted into the bottom of a thin glass basin of about 22 cm. diameter and 6 cm. depth. The pegs serve for the attachment of the small bars holding the seedlings. The glass dish is lined with moist filter paper and closed with a circular glass plate 24 cm. in diameter; the inner side of the cover is completely lined with a piece of moist blotting paper, which forms an almost perfectly tight fitting cover.

In case the plate of the klinostat is too small for the attachment of the basin, it must be fastened to a circular wooden plate, which is screwed to the plate of the klinostat and also serves for securing the cover clamp. The cut shows the manner of securing the cover and the dish. The clamp A is made of strong, elastic wood with disks of rubber under the extremities of the arms; one end of it slips into a loop of wire, a strip of brass at the other end hooks to the wooden plate P. The dish is held from slipping sideways by four pegs in the wooden plate, which may be covered with short pieces of rubber tubing. The seedlings for use should be attached to short wooden bars, which are fastened to the pegs inside of the dark chamber by means of two rubber bands. The strength of the centrifugal force, in terms of the attraction of gravity, may be calculated for the pegs from the following formula:



$$\frac{4\,\pi\,R\ (\text{in meters})}{gt^2},\ \frac{4\,\pi^2}{g} = 4.024,\ \text{a constant.}$$

$$4.024 \times \frac{R}{t^2} = \text{no. of g (gravity).}$$

R = radius expressed in meters.

t = time in seconds of one revolution of the chamber.

If the centrifugal force is small, i. e., less than three times the force of gravity, the seedlings may be attached to the wooden bars in the ordinary method by the use of rubber bands and strips of blotting paper; but if the centrifugal force is considerable, I have found it better to pack the seedlings in short pieces of glass tubing, allowing about 5 millimeters of the root-tip to protrude, then to fasten the pieces of glass tubing to the wooden bars. The pieces of tubing should be arranged so that they lie in a tangential plane.

For short periods of time the supply of moisture will not need to be replenished if the chamber is well saturated before beginning; in long continued experiments it is best to introduce more water by means of an atomizer every six or eight hours.

The advantages of such a chamber for use on the klinostat are that in the moist air the roots are freer to respond than in moist sawdust, where the higher rates of rotation invariably cause the sawdust to become packed at the circumference of the cylinder; the seedlings can be easily observed during the progress of the experiment; it retains its supply of moisture well,—I have seen corn seedlings grow for four days with only the initial supply of moisture; it can be rotated in any desired plane and at any speed.

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University of Michigan.

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Edited by L. B. ELLIOTT.

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SEPARATES.

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THE results of the Denver meeting of the American Association for the Advancement of Science undoubtedly came as an agreeable surprise to any who may have had fears for the success of a meeting so far from the center of American scientific activity. The reports of the meeting are most gratifying. The results accomplished during the past year, and the steps taken for the betterment of the organization in coming years, are of such interest as to bear repetition. We would also take this opportunity to congratulate those who assumed the responsibility of the arrangement of the recent meeting at Denver for the success with which their efforts have been rewarded. One more step in advance has been taken, and a closer and more efficient organization has been attained. The meeting was a success from every standpoint. The attendance approached that of recent eastern meetings, the registration reaching 311. That the Association is rallying after a period of gradual decrease in membership is assured by the fact that since the 1900 meeting, 1500 new members have been added. More than 200 papers were presented. The report of the financial condition of the Association was very encouraging, the permanent endowment fund having been increased during the year by over one thousand dollars, bringing the present amount of that fund to something over eleven thousand dollars.

Several changes of policy were either adopted or recommended for future consideration. Of these the most important is that of a change in the time of meeting, to conform with the recent action taken by the universities to establish a Convocation Week during the winter. It was recommended that the Association, with its affiliated societies, meet at Washington during the week in which New Year's day of 1903 falls, without, however, abandoning the summer meetings. Thus the plan for winter meetings will be given fair trial, and its permanent establishment will depend largely upon the success of the first winter meeting.

An amendment for the mutual advantage of the Association and its affiliated societies provides that each affiliated society be entitled to elect one member (two if the society has more than twenty-five members) as its representative in the council of the Association; thus forming a closer organization between all the societies concerned.

Another step, intended to add strength to the council, is the provision for the election each year of three councillors-at-large, who shall serve for a term of three years, thus giving greater permanency and efficiency to that body. It is proposed to lengthen the term of office of the secretaries of sections to five years, in order to give the sections the benefit of experienced service. The present term gives the secretary little more than time enough to become familiar with his duties.

Although we have noted only a very small part of the proceedings of the Denver meeting, it is sufficient to show that the American Association for the Advancement of Science is growing in size and efficiency, and is an organization to which all who are interested in scientific work can well afford to belong.

CURRENT BOTANICAL LITERATURE.

CHARLES J. CHAMBERLAIN.

Books for review and separates of papers on botanical subjects should be sent to Charles J. Chamberlain, University of Chicago, Chicago, Ill.

REVIEWS.

Hill, A. W. The distribution and character of connecting threads in the tissues of *Pinus sylvestris* and other allied species. Phil. Trans. of the Roy. Soc. of London, Ser. B., **194**: 83–125: pls. 31–35, 1901.

This paper, by Mr. Hill, constitutes Part I of an extensive study by Gardiner and Hill of " The Histology of the Cell Wall, with special reference to the mode of connection of cells." The purpose was to discover the extent and distribution of the connecting threads in any particular plant. The embryo and seedlings of *Pinus pinea* and the mature tissues of *Pinus sylvestris* were chosen as particularly favorable material. The endosperm was also studied in *P. pinea*. The endosperm consists chiefly of rather large, rounded cells, but a close examination shows that in many cases an internal division has occurred. The threads are evenly distributed in the young walls, but are grouped in the older walls. Near the cotyledons the cells are smaller, the threads thicker, and there are traces of ferment action. Ferments from the cotyledons pass into the endosperm through the threads, and by the same route, food materials pass from the endosperm to the embryo.

In the seedling the absorptive side of the cotyledon is more abundantly supplied with threads than the side not exposed to the endosperm. There are no threads in the external walls of the epidermis, and but very few connecting the guard cells with their neighbors. All parenchyma cells show a general resemblance in the character of their threads, the threads on the end walls being irregularly scattered, while on the side walls they are grouped. In the phloem, all the sieve tube threads show a characteristic median dot. The albuminious cells at the edge of the phloem of the leaf have their threads grouped in localized thickenings on the walls, and serve to pass materials from the mesophyll to the phloem. The very numerous threads of the root cap form a connection with the free surface of the root and with the periblem.

In the mature tissue of *P. sylvestris* the threads in the cortical tissue are similar to those of the seedling. In the phloem there is no connection between the sieve tubes and the bast parenchyma, or the starch medullary ray cells. The sieve tube threads on the radial walls have a median dot. The torus of the bordered pit is probably traversed by threads which soon disappear. In the leaf, the distribution is about the same as in the cotyledon. The endodermis, with very numerous threads, is in close connection with the cortex and the stele. In the pericycle, living cells are connected by threads, but there is no connection between the pericycle and the lignified transfusion tissue.

In general, the main direction of threads in the cortex and phloem is tangential. The transitory nature of certain threads explains the absence of threads between the sieve tubes and medullary ray cells. Except in the medullary rays,

and in the cork cambium, the threads are chiefly on the radial walls. This suggests that in conifers food supplies and stimuli are conducted mostly in a tangential and vertical direction. C. J. C.

Arnoldi, W. Beiträge zur Morphologie einiger Gymnospermen. I. Die Entwickelung des Endosperms bei Sequoia sempervirens. Bull. des Natur. de Moscou, Pp. 1–13, pls. 7–8, 1899.

In Gymnosperms, as a rule, only one embryo sac attains any considerable development. Very rarely two embryo sacs develop in *Taxus*, and in one instance, two embryo sacs have been seen in *Pinus sylvestris*. In *Sequoia*, however, several embryo sacs begin to develop, and in *Gnetum* it is the rule for several sacs to develop almost to maturity before one of them secures any decided advantage. Prof. Arnoldi has taken up the somewhat incomplete work of Shaw, and has made a careful study of the development of the endosperm of *Sequoia sempervirens*. Free nuclear division takes place in the usual manner in an evenly distributed peripheral layer of protoplasm, but very soon there is a denser accumulation of protoplasm at the lower end of the sac. When the formation of walls begins, three regions of the endosperm may be distinguished: the upper, the lower, and the middle. The upper, and particularly the lower, develop faster than the middle, so that the ends of the sac become filled with a solid tissue, while the nuclei are still almost free in the middle portion. Each nucleus of the middle portion now becomes surrounded by a wall which is open on the inner side; the walls grow inward, and when the center is reached walls are formed at the inner ends of the cells. The nucleus now begins to divide, and each of these cells ("alveoli") becomes divided into several cells. Archegonia are formed only from these alveolar cells of the middle region. At the time of fertilization, the upper and lower portions of the endosperm consist of small-celled tissue, while the middle portion is alveolar. Sequoia is regarded as a connecting link between Gnetum and the Angiosperms on the one hand, and between Gymnosperms and the Archegoniates on the other. C. J. C.

Arnoldi, W. Beiträge zur Morphologie und Entwickelungsgeschichte einiger Gymnospermen. II. Ueber die Corpuscula und Pollenschläuche bei Sequoia sempervirens. Bull. des Natur. de Moscou, Pp. 1–8, pls. 10–11, 1899.

The number of archegonia in *Sequoia* is very large, some of the writer's drawings showing as many as sixty. They sometimes occur singly, but are often grouped. In development they resemble the archegonia of the Cupressineæ, since they are often in direct contact with each other, and do not form any ventral canal cell. There are no proteid vacuoles. The neck consists of two cells, in this respect resembling the older Gymnosperms. The pollen tube grows through the nucellus, not between the nucellus and integument, as described by Shaw. At the time of fertilization the pollen tube contains the two male cells of equal size, and two small nuclei, one of which is the tube nucleus and the other "the nucleus of the cell which united the generative cell with the microspore wall." The general structure of the pollen tube and its contents agrees with the Cupressineæ. The morphological considerations, together with the geographical distribution, lead to the conclusion that *Sequoia* is nearly related to the ancient type from which the modern Araucarias and Cupressineæ have descended. C. J. C.

CYTOLOGY, EMBRYOLOGY, AND MICROSCOPICAL METHODS.

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Separates of papers and books on animal biology should be sent for review to Agnes M. Claypole, 125 N. Marengo avenue, Pasadena, Cal.

CURRENT LITERATURE.

Cade, A. Les Éléments Sécréteurs des glandes gastriques du fond chez les mammifères. Arch. d'Anatomie Microscopique, **4**: 1–86, 1901.

This article contains a description of the histological structure of the glands of the stomach in different stages of their normal activity, the changes in the glands during hibernation, the effects produced by pilocarpin, section of the vagus nerve, isolation of a part of the stomach, and the formation of an artificial pylorus in the region of the fundus. The cells of the fundus are grouped under three heads—cells of the neck of the gland, the central or chief cells, and the parietal cells. The material studied was obtained from the dog, cat, rat, mouse, hedge-hog, marmot, and, in a few cases, from man. Methods of fixation and staining are given, and the structure of the cells described in detail. The central or chief cells frequently contain two or more nuclei, and divide amitotically; careful research failed to discover a single case of karyokinesis. Amitosis is apparently the chief mode of division in the border cells also. The neck, or muciparous, cells exhibit transitions into the central cells, and the author inclines to the view that the one type may be transformed into the other, although it is admitted that this is not proven. A close connection exists between the neck cells and the epithelial cells of the surface of the mucosa, and there is a relationship between the neck cells of the fundus glands and the cells of the body of the pyloric glands. ("Il y a entre les cellules des grandes pyloricques et les cellules principales du col une certaine parenti.") There is no evidence of a transition either way between the chief cells and the border cells of the fundus; they apparently always remain specifically distinct elements. Contrary to the opinion held by Oppel and others that the cells of the body of the gland in the lower vertebrates represent only the parietal cells of the mammals, the author holds that they correspond to both parietal and chief cells of the higher forms. The theory that the parietal cells are especially concerned in the production of hydrochloric acid is considered devoid of adequate foundation.

Section of the vagus nerve gives rise to marked structural changes in the secreting cells. The border cells become less granular. The cytoplasm of the chief cells stains less deeply, and the cells lose the differentiated region at the base; the nucleus becomes shrunken and wrinkled in outline. Isolation of a part of the stomach gives rise to changes similar to those produced by section of the vagus. The author concludes that the vagus plays an important role in the secretion of the gastric juice.

The experiment of forming an artificial pylorus in the fundus of the

stomach gave very interesting results. The stomach of a cat was cut completely across in the middle, and a junction was made between the fundus and the jejunum, so that the pyloric region was entirely excluded from the route along which the food passed. A similar operation was performed on a dog, and both animals were killed about seven months afterward. A careful study was made of the histological changes that occurred in the region of the fundus near the line of juncture. Near the junction with the intestine the fundus glands became more sinuous, the lumen increased in size, and the interglandular tissue became infiltrated with leucocytes. The character of the gland cells was markedly altered. The parietal cells disappeared entirely; the chief cells lost their characteristic granulation, their basal differentiation disappeared, and they assumed the principal features of the cells of the neck. Both in general structure and in the character of the cells the fundus glands near the new pylorus became strikingly similar to the ordinary pyloric glands. This working over of the fundus glands into glands resembling those of the pyloric region in response to the new environing conditions imposed is a feature of considerable theoretical interest. There is a closing section on deductions concerning the process of secretion in general. S. J. H.

Conklin, E. G. Centrosome and Sphere in the Maturation, Fertilization, and Cleavage of Crepidula. Anat. Anz. **19**: 280–287, 1901.

This paper is a summary of a more extended publication which will soon appear in the *Journal of Morphology*. In fertilization there is no "quadrille" of the centers. The egg sphere and sperm sphere, however, fuse into a granular mass. Within this mass the centrosomes of the first cleavage spindle arise apparently independently of each other. The author holds that "there is good evidence that the cleavage centrosomes are not derived exclusively either from a sperm centrosome or from an egg centrosome, but that one of these comes from the egg sphere, the other from the sperm sphere." S. J. H.

Hoffmann, R. W. Ueber das Orientiren und Schneiden mikroskopisch kleiner, undurchsichtiger und dotterreicher Objecte. Zeit. wiss. Mik. **4**: 443–448, 1901.

While the consistency of yolk depends to a certain extent upon the fixing fluid employed, the length of time the object remains in alcohol and the duration of the process of embedding in paraffin were not found to have any influence on the ease with which yolk can be cut. No reliable method of treating yolk so as to be cut easily in paraffin was hit upon, so resource was had to embedding in celloidin. In orienting small opaque objects in celloidin, 90 per cent. alcohol is a serviceable medium in which to operate, as it enables one to see easily the configuration of the object, and only hardens the celloidin very slowly; 100 per cent. alcohol, which the author at first employed, dissolves the celloidin too much, and 85 per cent. alcohol hardens it too rapidly. After the object is oriented under a small amount of the alcohol it is placed in xylol to harden. The turbidity that appears after treatment with xylol soon disappears, and the mass becomes clear. One convenient method of orienting is as follows: A number of objects are impregnated with thick celloidin solution in a shallow glass dish, enough celloidin being used to form, after it is hardened, a mass but little thicker than the objects embedded. After the mass is hardened under 80 per cent. alcohol it is cut up into small, square pieces, one for each object. After being placed for some time in 90 per cent. alcohol, the objects are stuck to a block, oriented under a small amount of 90 per cent. alcohol, and then placed in xylol until hardened and cleared. S. J. H.

CURRENT ZOÖLOGICAL LITERATURE.

CHARLES A. KOFOID.

Books and separates of papers on zoölogical subjects should be sent for review to Charles A. Kofoid, University of California, Berkeley, California.

Siedlecki, M. Contribution à l'étude des changements cellulaires provoqués par les Gregarines. Arch. d' Anat. Micros. **4**: 87–100. Avec 9 figs., dans le texte. 1901.

Monocystis ascidiæ develops *within* a cell of the intestinal epithelium of *Ciona intestinalis* from the sporozoïte issuing from the sporocyst of the Gregarine in the intestine. The presence of the parasite in the cell provokes at first an hypertrophy of the nucleus and the cytoplasm. The chromatin is disorganized, and the nucleolus increases in size. These changes are due to the chemical action of the parasite. In material fixed in Flemming, or sublimate, the parasitized cells are but feebly stained by safranin, thionin, the various hæmatoxylins, or the Biondi mixture. The infected and greatly hypertrophied cell is pushed beneath the epithelial layer into a sac of connective tissue formed by the basement membrane. From this sac the *Monocystis* escapes by passing through the epithelial layer between the cells into the lumen of the digestive tract. Here it attaches itself by means of its small amœboid projection *upon* the epithelial cells, in which, however, it produces no pathological condition. *Pterocephalus*, parasitic in *Scolopendra*, lies, in its adult stage, *between* the cells of the intestinal epithelium attached to them by protoplasmic prolongations of the protomerite. The changes in the epithelium due to its presence are purely mechanical. C. A. K.

Miall, L. C., and Hammond, A. R. Structure and Life-history of the Harlequin Fly. Pp. vi, 196. With 127 figs., and 1 pl. The Clarendon Press, Oxford, 1900.

The revival of interest in the *Diptera* which has resulted from the discovery of the agency of mosquitoes and house-flies in the spreading of disease makes the publication of this book very opportune. Though *Chironomus* is not itself an obnoxious form, its structure and life-history are in many points so similar to those of the *Culicidæ*, that this work may well serve as a guide to students of that group. The anatomy and histology of both the larvæ and the adult are treated in detail with abundant original illustrations, and comparisons with other *Diptera* are frequently made. The habits, parasites, enemies, and the life-history are fully described.

Chironomus is widely distributed, and its larvæ abound in every body of fresh water, and also in some places in salt water in the littoral region. Slow, muddy streams rich in decaying organic matter constitute the best collecting grounds, and a long-handled ladle forms a good collecting instrument. Larvæ are easily reared in the laboratory in shallow aquaria with decaying vegetation. High temperatures favor their rapid transformation.

The study of the living larva is best made upon half-grown specimens entangled in a nest of cotton-wool. The external structure is best seen in specimens killed in Flemming's fluid, and the detail of the exoskeleton in specimens treated for three days in a ten per cent. solution of caustic potash, and then

mounted in glycerin or balsam. For histological study the larvæ may be killed in Flemming's fluid; after one hour's exposure they should be halved and again placed in the fluid for another hour, and then thoroughly washed in running water in a washing bottle for twenty-four hours. Perenyi's fluid for six hours also fixes the tissues very well; after three hours in the fluid the larvæ should be halved. Larvæ for entire mounts should be prepared as follows: Select transparent specimens and keep them in clear water for a day or two, until the alimentary canal is emptied. Then place the larva in a mixture of absolute alcohol (9 parts) and ether (1 part), holding it in the desired position with small sable brushes until it is set (three to ten minutes). After several hours' exposure to this fluid transfer to absolute alcohol so as to remove all the ether. Pass through oil of cloves to *new* benzine balsam. Many points in the anatomy may be elucidated by fresh specimens teased out in two per cent. caustic potash, or by those killed in the fluids above mentioned, and stained in carmin or hæmatoxylin before teasing out. In staining *in toto* with carmin or Delafield's hæmatoxylin it is necessary to permit the stains to act for at least a week. Material prepared by the methods above described may be successfully sectioned in either paraffin or celloidin. Serial sections in the paraffin are facilitated by coating the block with soft paraffin.

The peculiar nuclear structures of the salivary glands may be studied in material fixed in a fluid composed of equal parts of one per cent. osmic and acetic acids allowed to act for several minutes. The glands are then stained in acetized methyl green followed by carmin, and are mounted in glycerin. The glands are easily secured from decapitated larvæ, passing out with the blood, or being readily released by gentle pressure.

The eggs of *Chironomus* are very favorable objects for the study of insect development; they are abundant, quite transparent, and the larval stage is reached in the brief period of six days. The authors recommend hot, thirty per cent. alcohol half saturated with corrosive sublimate for killing the egg-chain for subsequent sectioning and staining by the Heidenhain method. C. A. K.

Guiart, J. Les Mollusques Tectibranches. Causeries Scientifiques de la Soc. Zool. de France, **1900**: 77–132, 4 pl. Avec 35 figs. dans le texte. 1900.

This is a *résumé* of the author's monograph of these mollusks, and is devoted principally to the *Bullidæ* and the *Aplysidæ*. A very complete outline is given of the gross anatomy of several types, and a modified classification is proposed for the group. The *Pleurobranchidæ* are included with the Nudibranchs, and the group, as a whole, are derived through some such form as *Acteon* from the Prosobranchs by a process of detorsion as shown in the comparative study of the nervous system. The author recommends the subcutaneous injection of one cubic centimeter of five or ten per cent. hydrochlorate of cocaine to overcome the extreme contractility of *Aplysia*. Muscular relaxation is thus secured in several minutes. Tissues may be fixed by injection of sublimate-acetic by way of the gill. This paper is one of an excellent series of lectures by specialists before the Zoölogical Society of France. C. A. K.

NORMAL AND PATHOLOGICAL HISTOLOGY.

JOSEPH H. PRATT.

Harvard University Medical School, Boston, Mass., to whom all books and papers on these subjects should be sent for review.

Michaelis, L. Ueber Fett-Farbstoffe. Virchow's Archiv für path. Anat. **164**: 263–270, 1901.

Much that relates to our histological staining methods is purely empirical. Hence Dr. Michaelis' attempt to determine chemically what part of the sudan III molecules gives the fat-staining property, and from this knowledge to synthetically prepare a more satisfactory stain, is very welcome. But why do we require a new stain or any stain for fat, a substance so easily recognizable both morphologically and by its high index of refraction? Unfortunately other substances, as the zymogen granules of the pancreas, eosinophilic granules, etc., are in these ways indistinguishable from fat. Osmic acid is not specific and does not color all fat, for Altmann has shown that osmic acid colors only the oleic acid fats. Sudan III has not proven perfectly satisfactory.

Sudan III is azobenzol-azo β naphthol. Michaelis first assumes that the double azo group lends the fat-coloring property to the molecule. However, he finds that a stain with a simpler azo group (benzol-azo β naphthol) will color fat. Another stain, differing from last only in being α instead of β naphthol, stains tissues diffusely. This latter is soluble in alkalies, while the former is soluble neither in alkalies nor acids, but only in organic solvents, thus resembling sudan III. In experimenting he finds that the staining reaction of the β compound does not depend on the orthoposition of the azo group to the OH group, but in the lack of a free OH group — in other words the lack of a salt-forming group. So he concludes that fat-stains are those azo bodies which possess no salt-forming group — indifferent coloring stuffs in opposition to acid and basic.

Knowing this, he prepares synthetically azoorthotulolazo β naphthol (scharlach R or fettponceau), which gives better results than sudan III, coloring very small droplets of fat bright red. This stain is insoluble in water, acids and alkalies, soluble with difficulty in alcohol, and easily soluble in chloroform, fatty oils and melted paraffin.

The technique for its employment is—

1. Tissues preserved in formol.
2. Freezing microtome sections.
3. Saturated solution of scharlach R in 60-70% alcohol for fifteen to thirty minutes.
4. Counterstain with hæmatoxylin.
5. Mount in glycerine or levulose syrup.

H. A. CHRISTIAN.

Feldbausch, F. Ueber das Vorkommen von eosinophilen Leukocyten in Tumoren. Virchow's Archiv. f. path. Anat. **161**: 1–18, 1900.

Goldmann, Müller, Rieder, and Reinbach have previously called attention to the presence of large numbers of eosinophilic leucocytes in certain tumors.

Feldbausch has found in epidermoid carcinomas almost constantly a marked increase of the eosinophiles, while in adeno-carcinomas and sarcomas this does not occur. The eosinophiles lie chiefly in the connective tissue surrounding the masses of tumor cells. They form part of the cellular infiltration which owes its origin to inflammatory irritants of chemical, bacterial, or mechanical nature. They are present in greater number in the earlier stages of the development of the tumor, and also in the beginning of inflammations, than later when degeneration has occurred.

This investigation throws little if any light on the origin of eosinophiles. The author does not believe they arise *in loco*. Although he admits that Ehrlich's view that the cells develop in the bone-marrow may be correct, he thinks they may also be formed in the blood. The eosinophilic granules, he holds, are not formed by the ingestion of broken-down red blood corpuscles. The researches of Arnold have shown that the granules belong to the structural elements of the cell, and hence cannot arise through phagocytosis. Eosinophiles are often found in great number in places where no hemorrhage has occurred, and are often not found where destruction of red blood corpuscles regularly takes place, as in the liver and spleen, or where hemorrhage has occurred. J. H. P.

Edmunds, W. The Pathology and Diseases of the Thyroid Gland. Lancet, 1: p. 1317, 1901.

Recent researches have shown that the parathyroid glands are of great importance to the organism. Removal of these bodies usually causes the death of the animal. The parathyroid glands differ in structure from the thyroid gland in that they consist wholly of cells and contain no vesicles and no colloid, or at most a minute droplet.

It is not easy to identify the parathyroid glands in the human subject, because some of the minute outlying nodules are found to consist of ordinary thyroid tissue, and to be therefore accessory glands. The anatomy of the parathyroid gland in man has been worked out by Welsh of Edinburgh. He finds that there are four of these glands—one anterior and inferior to, one posterior and superior to, each thyroid lobe.

Although no symptoms occur as a consequence of the removal of one lobe of the thyroid gland, the other lobe, as pointed out by Wagner, hypertrophies. The vesicles enlarge and become branched, their lining membrane becomes folded, the cubical secreting cells become columnar, and the colloid disappears and is replaced by a mucous secretion which takes the staining reagents badly.

In dogs, if one parathyroid gland be dissected free from the thyroid lobe, taking care not to interfere with its blood supply, and the entire thyroid gland with the other parathyroid glands be excised, so that only one parathyroid be left in the animal, the dog will live and no obvious effects will ensue. The parathroid that is left in these experiments shows signs of more active growth than the normal, but it does not develop into thyroid tissue proper. No vesicles form. This disposes of the view once held that the parathyroid glands are undeveloped thyroid tissue.

Edmunds excised the parathyroids in a number of dogs, leaving the thyroid intact. Interesting changes occurred in the thyroid. The colloid diminished, or completely disappeared, and its place was taken by a watery fluid; the

vesicles, instead of remaining round became branched, and the secreting cells became columnar, or multiplying, filled the cavity of the vesicles with round cells. These changes are identical with those described as "compensatory hypertrophy," but the thyroid lobes did not enlarge, on the contrary, sometimes they seemed to become smaller. This would coincide with the view that the parathyroids manufacture the secretion, and the thyroid stores it; when the parathyroid had been removed there would be no secretion for the thyroid to store.

In a number of dogs important histological changes followed excision of a portion of the superior laryngeal and vaso-sympathetic nerves on one side, and the lateral thyroid lobe on the other side. The colloid disappeared from the remainder of the thyroid. Usually the secreting cells multiplied into the cavity of the vesicle. In one case, the dog having survived the experiment, the lobe was excised 49 days later. It was greatly enlarged and weighed 35 grams, which is three or four times the normal weight. The proliferated secreting cells did not fill the cavities, which contained instead a watery secretion. The great size of the lobe was due to a growth of young thyroid tissue between the vesicles. This shows the possibility of defective innervation being the cause of serious symptoms and pathological changes. J. H. P.

GENERAL PHYSIOLOGY.

RAYMOND PEARL.

Books and papers for review should be sent to Raymond Pearl, Zoölogical Laboratory, University of Michigan, Ann Arbor, Mich.

Dale, H. H. Galvanotaxis and Chemotaxis of Ciliate Infusoria. Part I. Jour. Physiol. **26**: 291–361, 1901.

In this work detailed comparisons were made between the chemotactic and electrotactic reactions of certain organisms, for the purpose of determining to what extent the electric current stimulates through its chemical action. The experimental work was done mainly on the infusoria parasitic in the intestine of the frog. The species used were: *Balantidium duodeni*, *B. elongatum*, *B. entozoon*, *Nyctotherus cordiformis*, and *Opalina ranarum*. On account of the high osmotic pressure of the medium in which these organisms normally live it was necessary to examine them in a solution of approximately equal concentration. A .6 per cent. solution of NaCl was used for this purpose, the organisms being shaken directly into it from the intestine. It was found that the chemical reaction of the solution in which the infusoria were placed had a very marked influence on their responses, so that it was necessary to conduct parallel experiments with solutions carefully made acid, neutral or alkaline. The chemotaxis was tested by introducing into the solution containing the organisms, either on a slide or in a watch-glass, capillary tubes filled with the test solutions. The principal solutions employed for testing the chemotaxis were an organic acid (acetic or butyric), a mineral acid (H_2SO_4), and an alkali (NaOH or Na_2CO_3). The electrotactic experiments were performed in the usual way with a stimulation trough, to which the current

was led through unpolarisable, brush electrodes. The current was obtained from a battery of small bichromate cells.

The reactions of *Opalina* are first discussed. It was found that this form, when in an alkalinated or neutralised medium, showed an "attraction" to (i. e., formed a collection in) an acid test solution and a "repulsion" from an alkaline, and, in response to the electrical stimulus, collected at the anode. If the salt solution containing the organisms was acidified the reactions were reversed, collections being formed in the alkaline test solution and at the kathode pole. The reactions of *Nyctotherus* showed a still closer dependence on the chemical reaction of the medium than did those of *Opalina*. In a strongly alkalinated medium *Nyctotherus* collected in acids and at the anode pole. In a weakly alkalinated medium these organisms collected in weakly acid test solutions and were "repulsed" from strong acids and from alkalis of all strengths. In response to the electric current collections were formed at the anode except in very strong currents, when there was a transverse orientation. In a neutral medium there was "repulsion" from both acids and alkaline test solutions and the electrotactic reaction was transverse to the direction of the current. Passing to the reactions in acid media, it was found that when in a weakly acid salt solution, the organisms formed collections in weakly alkaline test solutions and at the kathode pole. "Repulsion" occurred from strong alkalis and from acids of any strength. With strong electric currents there occurred again the transverse orientation. In a strongly acid medium collections were formed in alkaline test solutions and at the kathode. Under all conditions except when in strongly alkalinated media *Balantidium elongatum* collected in alkaline test solutions and at the kathode pole. In strongly alkalinated saline, however, this form collected in weakly acid test solutions and exhibited a diphasic reaction to strong solutions, being first "attracted" to the acid and then in a short time passing over to the alkali. In this strongly alkaline medium there was also a diphasic reaction to the current. An immediate movement to the anode was replaced—after a time dependent on the strength of the current—by motion towards and collection at the kathode. Without going into the details of the individual cases it may be stated that in the two other species studied, *Balantidium entozoon* and *B. duodeni*, essentially similar reactions were found. In all cases there was a distinct parallelism between the chemotaxis and the electrotaxis.

The ciliary action in these responses was studied principally in *Opalina* and *Nyctotherus*. *Opalina* reacts to repellent stimuli by a response like the "motor reflex" of the free living infusoria as described by Jennings. This reaction brings about its "repulsion" from alkalis. Its collections in acid solutions are, however, the result of a different sort of a response. When the anterior end of the organism comes in contact with a weak acid the ciliary waves change their direction in such a way as to directly orient the body along the lines of diffusion. The organism then swims toward the center of diffusion. This is probably the first clear case recorded in the literature where an infusorian becomes directly oriented along the path of diffusion of ions, and forms collections in solutions as a result of such a response. The orientation to the electric current is brought about by a rotation as in the ordinary "motor reflex" until the anterior end is towards

the anode or the kathode as the case may be. There is no ciliary reversal on the kathode half of the body, as has been described by several observers in the case of the free living infusoria. The author lays stress on the parallelism in the forms he has studied between the effect of chemical and electrical stimuli on the ciliary action.

Experiments were made with media of different electrical conductivities. It was found that in both hyper- and hypotonic solutions *Opalina* and *Nyctotherus* show a tendency to pass to the kathode pole, although the reaction varies somewhat. Experiments with *Paramecium* and *Colpidium* in salt solutions showed that, under these conditions, both of these ordinarily kathodic forms went to the anode when the current was passed. It is maintained that probably nearly all the ordinarily described electrotactic reactions are conditioned by the conductivity of the solution in which they are tested, and that they may disappear or be replaced by very different responses under different conditions.

The author considers the general phenomenon of electrotaxis to be the result of two factors; one, a rheotactic reaction to the current of fluid produced by the kataphoric action of the electric current, and the other a chemotactic reaction to the acid continually set free at the anodic, and the alkali at the kathodic end of the body. Whatever may be one's opinion as to the adequacy of this theory, the work as a whole is an extremely important and well developed contribution to the discussion of the phenomenon of electrotaxis. R. P.

Jennings, H. S. On the Significance of the Spiral Swimming of Organisms. Amer. Nat. **35**: 369–378, 1901.

It has long been known that a great many lower organisms (e. g., swarmspores, flagellate and ciliate infusoria, rotifers, and others) swim in a spiral path. It is the purpose of the present paper to explain the biological significance of this form of progression. It is very clearly shown by Dr. Jennings that the purpose and result of this movement in a spiral is to keep the animal on a straight course. Most of the infusoria are unsymmetrical, and as they start to move forward they are swerved from a straight course as a result of this asymmetry. This swerving is always towards the same, structurally defined, side of the body. If, however, as is in fact the case, the organism rotates on its long axis as it advances, it is at once apparent that any tendency to swerve to one side from the straight course will compensate itself, thus leaving the forward component of the motion the only effective one, and making the path a spiral with a straight axis. This method of swimming is closely related to the method of reaction to stimuli of these organisms, since the side of the body towards which the infusorian turns in the "motor reflex" is always directed away from the axis of the spiral. Not only asymmetrical organisms use this method of keeping on a straight course, but many bilaterally symmetrical rotifers also swim in a spiral path. These rotifers have a marked tendency, when moving freely in the water, to swerve towards the dorsal side. This tendency is the one compensated for by the spiral swimming in this case. Correlations between the method of movement and the form of the body in other cases are discussed. R. P.

NOTES ON RECENT MINERALOGICAL LITERATURE.

ALFRED J. MOSES AND LEA MCI. LUQUER.

Books and reprints for review should be sent to Alfred J. Moses, Columbia University, New York, N. Y.

Clarke, F. W., and Steiger, George. Experiments Relative to the Constitution of Pectolite, Pyrophyllite, Calamine, and Analcite. Am. Jour. Sci. iv, **8**: 245, 1899.

The article treats of the fractional analysis of silicates by means of various reagents, in order to gain evidence bearing upon their chemical structure.

Pectolite proved to be a true metasilicate by ignition and solution in sodium carbonate, the mineral being decomposed and losing practically $\frac{1}{6}$ of its SiO_2, as required by theory.

Pyrophyllite not proved to be a metasilicate by same test. May be regarded as having formula, Si_2O_5=Al—OH.

Calamine tests as a rule yielded negative results, but supported the usual formula.

Analcite appeared not to be a metasilicate, but may be a mixture of ortho- and tri-silicate, represented by formula, $Al_4Na_4(SiO_4)_2(Si_3O_8)_2 \cdot 4H_2O$.

Analcite and leucite determined by authors to belong to garnet-sodalite group.

L. McI. L.

Prior, G. T. and Spencer, L. J. The Identity of Binnite with Tennantite, and the Chemical Composition of Fahlerz. Min. Mag. **12**: 184, 1899.

Binnite possesses the same degree of symmetry as the Cornish *tennantite*, being simply better developed and having more and brighter faces.

Tetrahedrite (Fahlerz) appears to have the formula $3\ Cu_2S.\ (Sb.As)_2S_3$ in the case of the simple sulphantimonite or sulpharsenite of copper. The Fe and Zn appear to be the disturbing elements, producing the 4 : 1 original formula of Rose.

As a result of many analyses the author proposes the new formula $3\ R'_2S \cdot R'''_2S_3 + x[6\ R''S \cdot R'''_2S_3]$, in which R'=Cu, Ag; R''=Fe Zn; R'''=Sb, As, Bi; and x=a small fraction, often $\frac{1}{10}$ or $\frac{1}{5}$, but rising to $\frac{1}{2}$ in the case of the highly ferriferous tetrahedrite "coppite."

Many tests of the new formula are given by reference to to analyses.

L. McI. L.

Hartley, E. G. G. Communications from the Oxford Mineralogical Laboratory on the Constitution of the Natural Arsenates and Phosphates. Min. Mag. **12**: 152, 1899.

Pharmacosiderite.—As a result of careful analysis, in green Cornish crystals, the following formula was proposed:

$$2\ Fe\ AsO_4 \cdot Fe[O(H, K)]_3 \cdot 5\ H_2O.$$

The undoubted presence of K (new to pharmacosiderite) is of interest.

During the course of the investigation, the apparent permeability of the mineral to certain liquids was shown. A green transparent crystal immersed in ammonia turned red, and became green again in hydrochloric acid.

L. McI. L.

Neuwirth, V. Titanit von der Hüttellehne bei Wermsdorf un Mähren. Tschermak's Min. u. petrog. Mitth. **20**: 178–180, 1901.

Asparagus green crystals 4 x 3 mm. Crystallographic description.

A. J. M.

Martin, Fr. Ueber Scheinbar spaltbaren Quarz von Karlsbad. Tschermak's Min. u. petrog. Mitth. **20**: 80–82, 1900.

Quartz kernels from an old wall are imperfect crystals. Under action of frost certain liquid inclusions which are arranged parallel R, ∞ P and sometimes *o* P, have produced apparent cleavages.

A. J. M.

Erben, F., and Ceipek, L. Analyse des Albits von Amelia. Tschermak's Min. u. petrog. Mitth. **20**: 85, 1900.

Leading to formula $Ab_{95}An_5$.

A. J. M.

Judd, Hidden, and Pratt. On a New Mode of Occurence of Ruby in North Carolina. Min. Mag. **12**: 139, 1899.

The specimens are almost similar in beauty and color to those from the Mogok district of Burma, and certain garnet (rhodolite)-bearing basic rocks at Cowee-Creek, the ruby having probably crystallized out from the basic fluid magma. The "non-gem" corundum occurs in ordinary crystalline schists, or in peridotites.

The rubies frequently contain inclusions of various kinds, and the clearest crystals almost always show the tabular habit, regarded by Lagoria as characteristic of those separating from an igneous magma.

A pseudomorphous change by hydration is very common, as in the case of the Burma rubies, and it is hoped that more investigation will bring to light the similarity in rock magma producing the Burma and North Carolina rubies.

L. McI. L.

Pratt, J. H. On the Crystallography of the Rubies from Macon Co., N. C. Min. Mag. **12**: 150, 1899.

The Cowee Valley crystals have two general habits:

(1) Flat tabular, a combination of base and unit rhombohedron.

(2) Prism *a* $(11\bar{2}0)$, prominently developed with base, the prism being either short or long. Pyramidal faces *n* $(22\bar{4}3)$ sometimes show.

Basal planes are striated, or show repeated growth of unit R and base.

Similarity in development is noted between these rubies and the corundums from Yogo Gulch, Mont., and the Burma district.

L. McI. L.

MEDICAL NOTES.

Blood Examination.—The following method for the preparation of specimens for the examination of blood is given by Dr. W. L. Braddon, of the Malay Peninsula: The mounts may be made either between two square cover-glasses, or a square cover-glass and a regular size slide. The covers and slides are first sterilized by a method recommended by Parker and Howard; viz., drop, *one by one*, into a 10 per cent. solution of chromic acid, contained in an enamelled iron dish, and boil for twenty minutes. They are then poured, altogether, into a

shallow basin, and washed with ordinary tap water until no trace of the yellow color of chromic acid remains. The water is next poured off, and the slips are covered with rectified spirit. After this they are washed in absolute alcohol, and handled with clean forceps.

If two cover-glasses are used for the mount, they are accurately superposed and firmly pressed together. An edging of vaseline, if for temporary purposes, or cement if for permanent purposes, is laid over all the edges, except one, and a very small portion of that edge which is opposite the uncemented one. A drop of blood is touched with the free edge of the paired cover-glasses, whereupon the blood enters between the glasses in an exceedingly thin film, the corpuscles being spread out with beautiful uniformity, and having suffered a minimum amount of change from exposure to air and none at all from handling or pressure. When the blood film has entered, the free edges may be completely closed, and the examination made.

If slide and cover-glass are used the latter is placed on the slide in such a position that one of its edges exactly coincides with that of the slide. It is then firmly pressed, and sealed with vaseline or cement, as when two cover-glasses are used, and the subsequent course pursued as with covers. By this method a number of mounts may be made and stored in a suitable air-tight bottle, and thus be always ready for use. Fresh blood keeps well under these circumstances. No special skill is required for the making of first-class blood film.

This method has been carefully tested, and it was found necessary to put the smallest possible amount of cement between the covers before edging them outside, otherwise the cement had a tendency to run in.—*Knowledge*, **24**: 183.

C. W. J.

Methods of Staining the Gonococcus.

Schütz method:

1. Stain for five to ten minutes in sat. sol. methylen blue in 5 per cent. carbolic acid water.
2. Differentiate for three seconds in:

   Acetic acid, . . . 1 part.
   Water, dist., ... 4 parts.
3. Wash in distilled water.
4. Counterstain in dilute solution of safranin.

Neisser's method:

1. Stain in conc. alc. sol. of eosin, slightly warmed, for two or three minutes.
2. Remove excess of stain with filter paper, and counterstain with conc. alc. sol. methylen blue for fifteen to thirty seconds.

Chenzinski's methylen blue and eosin:

Methylen blue, sat. aq. sol., . . . 2 parts.
Eosin, 0.5 per cent. in 70 per cent. alcohol, . 1 part.
Distilled water or glycerin, . . . 2 parts.

With this solution cocci stain blue, pus cells pink.

NEWS AND NOTES.

The University of Zurich has enlarged its anatomical building. A dissecting room, with overhead light, to accommodate two hundred students, has been added, and on the floor below a microscopical room of the same size. There is also a demonstration room with overhead light, a laboratory for anthropology, and a laboratory for advanced embryological study, together with rooms for the director. The old part of the building will be rearranged for a large lecture room, a reading and study room for the students, a museum, and the laboratories for assistants.—*Science*, **14**: 347.

The Bureau of Plant Industry of the U. S. Dept. of Agri. has recently been reorganized, and, with Beverly T. Galloway as chief, now embraces the following groups: Vegetable pathological and physiological investigations, Alferd J. Wood in charge; Botanical investigations and experiments, Frederick V. Coville; Pomological investigations, Gustavus B. Brachett; Grass and Forage Plant investigations, F. Lamson Scribner; Experimental Gardens and Grounds, L. C. Corbett; Congressional Seed Distribution, Robert J. Whittleton; Seed and Plant introduction, Ernst A. Bessey; Tea Culture experiments, Charles U. Shepard; and the Arlington Experimental Farm, L. C. Corbett.—*Bot. Gaz.* **32**: 2.

QUESTION BOX.

Inquiries will be printed in this department from any inquirer.
The replies will appear as received.

13. Is there a simple, satisfactory method of determining whether or not a given sample of milk contains bacteria, that can be performed with the aid of a microscope the highest power of which is a one-fourth inch objective?

I. G. B.

14. What is Tallquist's method of blood examination and estimation of hemoglobin? R. C. W.

15. Can specimens (animal) preserved in alcohol for a long time be safely transferred to formalin? J. D.

16. I am working on the various methods of fixing or producing death in the animal organism and cell. My work ranges from micro-organisms to vertebrates, and requires specimens for dissection killed in such a manner as not to show the distortion due to contraction of the muscular tissues, such as occurs when death is produced by chloroform, ether, or other anæsthetic. The reagents I employ in the preparation of dissections for demonstrating will probably react unfavorably with any metallic poisonous compound that might be employed. The substance used should produce death as immediately as possible, in order to avoid maceration or pathological changes, and should be practically tasteless, with no irritating odor, and capable of being used in minute or minimum quantities with delicate water animals, etc. If you can suggest such a substance, or anything which would lead to similar results, it would be greatly appreciated. G. W. B.

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ROSY COLOR.

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"When a person rises from each meal with a ringing in the ears and a general sense of nervousness, it is a common habit to charge it to a deranged stomach.

I found it was caused from drinking coffee, which I never suspected for a long time, but found by leaving off coffee that the disagreeable feelings went away.

I was brought to think of the subject by getting some Postum Food Coffee, and this brought me out of trouble.

It is a most appetizing and invigorating beverage and has been of such great benefit to me that I naturally speak of it from time to time as opportunity offers.

A lady friend complained to me that she had tried Postum, but it did not taste good. In reply to my question she said she guessed she boiled it about ten minutes. I advised her to follow directions and know that she boiled it fifteen or twenty minutes, and she would have something worth talking about. A short time ago I heard one of her children say that they were drinking Postum now-a-days, so I judge she succeeded in making it good, which is by no means a difficult task.

Tom O'Brien, the son of a friend who lives on Bridge street, was formerly a pale lad, but since he has been drinking Postum, has a fine color. There is plenty of evidence that Postum actually does 'make red blood,' as the famous trade mark says." Jno. Chambers, 9 Franklin street, Dayton, Ohio.

QUIT WHITE BREAD.

COULD NOT GET STRENGTH FROM IT.

An Episcopalian minister of Ellenville, N. Y., who is interested not only in the spiritual welfare of his congregation, but in their physical well-being also, says: "I can now do an immense amount of work and feel no fatigue, for the reason that I am using Grape-Nuts breakfast food and have quit coffee entirely and am using Postum Food Coffee.

Myself and family are all greatly improved in health. We have largely abandoned the use of white bread. Upwards of twenty-five persons have changed their diet, on my recommendation. It is gladly given, because I know, from personal experience, whereof I speak."

It is a well known fact that white bread is almost entirely composed of starch, and this is difficult of digestion by many people, particularly those who have weak intestinal digestion. The result of the use of much white bread is a lack of brain and nervous power to do mental work and it also creates intestinal troubles, because the excess of starch ferments in the intestines and makes the conditions right for the growth of microbes; whereas Grape-Nuts breakfast food contains the needed starch, but in a predigested form. That is, it is transformed into grape sugar in the process of manufacture and delivered in the packages, ready cooked, and in such shape that it is immediately assimilated without hard work of the digestive organs.

The food also contains the delicate particles of phosphate of potash which, combined with albumen, is used by nature to make the gray matter that must be in the cells of the brain and the nerve centers throughout the body, in order to give strength and ability to stand long and continuous work. Both the Postum Food Coffee and Grape-Nuts are sold by all first-class grocers.

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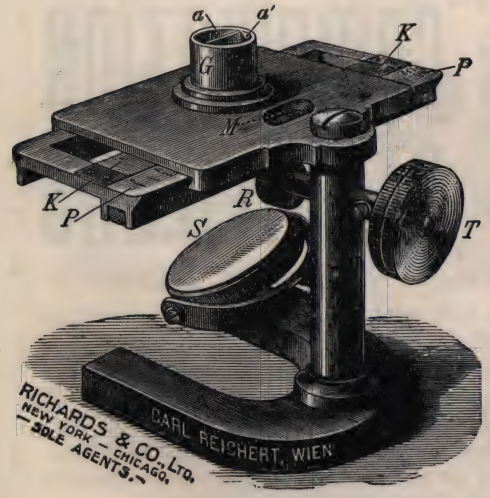

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